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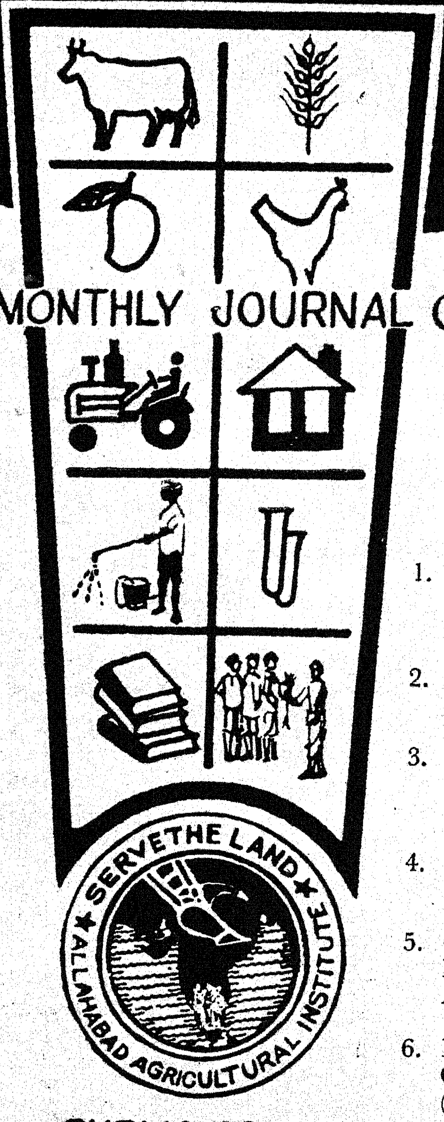

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Manuscripts dealing with all aspects of agriculture and rural life, eductional or research, are accepted for publication in *The Allahabad Farmer*. Manuscripts should ordinarily have more than purely local interest. Articles must be original material previously unpublished elsewhere. After review, each manuscript will be accepted for publication upon recommendation of the Managing Committee.

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Effect of Nitrogen and Phosphorus Fertilization on Yield and Protein Content of Wheat.[1]

S. D. SINGH and J. V. PRASAD

Numerous studies have shown the value of N fertilization in increasing the yield of wheat. The Department of Agriculture, U.P., recommended the use of 56 Kg. N/ha for this crop. This recommendation, at best, was only exploratory because it may not apply equally well in all situations. Therefore, the need for collecting information on the N requirements of wheat crop under specific conditions is imperative. This could be done by applying N in varying doses and by ascertaining the most economical dose. Again, it has conclusively been established that the efficiency of N is increased when applied in conjunction with P (2, 11). But the extent of effectiveness of this combination needs clearly be determined to assess the economics of P fertilization. Hence, this study was conducted to obtain information relating to the effects of N and P fertilization on yield and also the grain protein content of wheat.

MATERIALS AND METHODS

This experiment was conducted at the Agricultural Farm of J. V. College, Baraut (Dist. Meerut), U.P. The surface soil of the experimental plot had a pH of 7.8 and contained 0.042% N, 1.103% total P_2O_5, 0.069% $NaHCO_3$—extractable P, 1.09% total K_2O at the initiation of the study.

Wheat variety N.P. 718 was seeded on November 5, 1964. Nitrogen levels were 0, 12, 24, 36, 48, and 60 Kg. N/ha, applied broadcast immediately before seeding. Phosphorus levels were 0, 24, 48, and 72 Kg. P_2O_5/ha, placed at the time of sowing. Ammonium sulphate was the source of N and the P source was single superphosphate. The experimental design was a complex randomized blocks with 3 replications of 7x4 m-plots.

Soil nitrogen was determined by modified Kjeldahl method (1); phosphorus by Lorenz method as described by Piper (10); available P_2O_5 by Olsen's method (9); total potash by

[1]Contribution from the Division of Agronomy, J. V. College, Baraut (Meerut).

Piper's method (10), and pH with a glass electrode on a Beckman pH meter using a 1:2.5 soil: water ratio. Nitrogen in grain was determined by micro-Kjeldahl method (1) and per-cent, protein was calculated by multiplying percent N by 5.7 All data were analyzed statistically using standard procedure outlined by Snedecor (14).

RESULTS AND DISCUSSION

Yield and Components of Yield:

A summary of the mean square values of the individual analyses of variance for grain yield and components of yield appears in Table 1. A summary of the data is given in Table 2. N fertilization caused a significant increase in grain yield, plant density and grain yield per plant but did not cause a significant change in ear-bearing shoots, number of grains per ear and the weight of 1,000 grains.

It may be inferred from data in Table 2 that no nitrogen plot yielded an average mean yield of 13.7 q/ha. This yield was increased to 16.8, 17.4, 17.5, 20.5, and 23.7 q/ha in plots treated with successive increased doses of N. This shows that increase in yield was essentially a linear function of N application. The 60-Kg. N rate did not produce yield different from that obtained in plots fertilized with 48 Kg. N. But this yield was significantly better than those produced by other treatments. The initial 12 Kg. dose of N did not produce yield more than that of no-nitrogen plot. However, 24, 36, and 48 Kg. N rates tended to produce grain yields higher than that of no-nitrogen plot. The initial 3 doses of N did not differ significantly among themselves.

Even though the N-variance for all the three components of plant yield was not significant (Table 1), the yield per plant differed under different levels of N. This suggests that the plant density and yield per plant accounted for the high yield from 60 Kg. N-treated plot. The difference in yields per plant of 60 Kg. and 48 Kg. N-treated plots was non-significant. But the plant population was significantly higher in the former. This shows that 60 Kg. N-treated plots with higher plant density and equal plant yield could not produce a yield statistically superior to that of 48 Kg-treated plots. Thus an increase in plant population with an undetected decrease in one or more of the yield attributes in 60 Kg-treated plots probably resulted in the production of a yield statistically at par with that of 48 Kg-treated plots. These results lend strong support to the views of Hobbs (6) who stressed that increase in yield was duc mainly to an increase in stand count (no. of heads per unit area). The beneficial effect of N in boosting up wheat yield has been reported by several investigators (5, 7, 12, 13).

P fertilization caused a significant increase in grain yield per plant (Table 1). Probably this was brought about by a significant change in ear-bearing shoots per plant and the number of grains per ear. However, the total grain yield and 1000-grain weight remained unchanged by P fertilization (Table 3). But P fertilization has given a steady increase in yield and yield attributes. The noteworthy point is that while the plant density, plant yield, and two of the three plant yield attributes were modified by P fertilization, the grain yield remained unaffected. This suggests that the beneficial effect of P finally became non-existent.

The straw yield and components of yield were modified by N application. Significant were the treatment differences in respect of total straw yield, yield per plant, and plant height

(Table 4). Data presented in Table 5 indicate that the maximum yield of straw was obtained from 60 Kg. N-treated plots. But this yield and that of 48 Kg-treated plots were of equal order. Probably the high plant population and the straw yield per plant conjointly accounted for such a high yield in 60 Kg-treated plot. The contribution of plant height appears to be minor in this study.

Application of P reflected in a significant change in the number of total shoots per plant, plant height and plant density, the three attributes of straw yield (Table 4). But these attributes failed to increase the straw yield per plant and per hectare, as these yield remained unaffected by P fertilization (Table 6). However, a steady increase in the yield of straw per plant and per hectare was noted.

Grain Yield Curve:

The response to doses of N was found to be significant. It was, therefore, considered necessary to work out the response curve to know the nature of yields at different levels of N. For selecting a regression equation, the treatment variance was further partitioned into its linear, quadratic and other components of higher order. After testing the significance of these components (Table 7), linear equation was fitted to the yield data for expressing them as a function of applied N. The equation and its corresponding curve have been presented in Fig. 1. Since an ascending straight-line equation gave a good fit to the yield data, it may be said that grain yield exhibited a tendency to increase with increase in the level of N.

Grain Protein Percentage:

Mean square value in Table 8 indicates that a significant change occurred in grain protein percentage by N fertilization. Data presented in Table 9 reveal that application of N has given a steady increase in protein content of grain. The maximum protein content was obtained in grain from plots dressed with 60 Kg. N/ha. The grain from no-nitrogen plot had the minimum protein content. An increase in protein due to N fertilization is the general effect of applied N on protein content observed by other invstigators (3, 4, 15). With large applications, N fertilization increased vegetative growth, which gave higher grain yield, and increased the N available to the plant during grain formation, which resulted in the production of grain with a high N content.

The mean square value in Table 8 shows that P-level variance was highly significant. A summary of data in Table 10 reveals that P fertilization tended to decrease grain protein content. The maximum protein content (10.65%) was recorded in grain from unphosphated plot. This decreased to 10.29% in grain from 72 Kg-treated plots. This is in conformity with the findings of Eck *et al.* (3) who held that P fertilization tended to decrease grain protein content. The major portion of the decrease may be attributed to the fact that P increased yield, thus a given amount of available N spread throughout more grain, giving lowered protein content.

SUMMARY AND CONCLUSIONS

A field study was made of the influence of N and P fertilization on yield and grain protein of wheat. N was applied at the rate of 0, 12, 24, 36, 48 and 60 Kg. and phosphorus at 0, 24, 48, and 72 Kg. per hectare. The following results were obained:

1. N fertilization made a significant change both in grain yield per plant and per hectare. But ear-bearings shoots and number of grains per ear remained unaffected. The maximum yield obtained from 60 Kg-treated plot was statistically at par with that of 48 Kg-treated plot. This was brought about by almost a similar effect of N on yield per plant.

2. P fertilization resulted in a significant change in grain yield components. These components, however, failed to modify the total yield, which remained unaffected by P application.

3. Application of N resulted in a steady increase in straw yield with increase in the level of N. The maximum straw was recorded in 60 Kg-treated plots. With one exception, the straw yield per plant behaved in the same way as the total straw yield. Conversely, P fertilization did not modify the straw yield per plant and per hectare.

4. Increase in grain yield was a linear function of applied N. This suggests that a farmer may apply any dose of N within the range tested, depending upon his capacity to invest (capital and credit) and sustain price uncertainty and natural risks involved.

5. The response to P and to interaction N×P was found to be non-significant.

6. N fertilization increased grain protein, whereas P fertilization decreased grain protein.

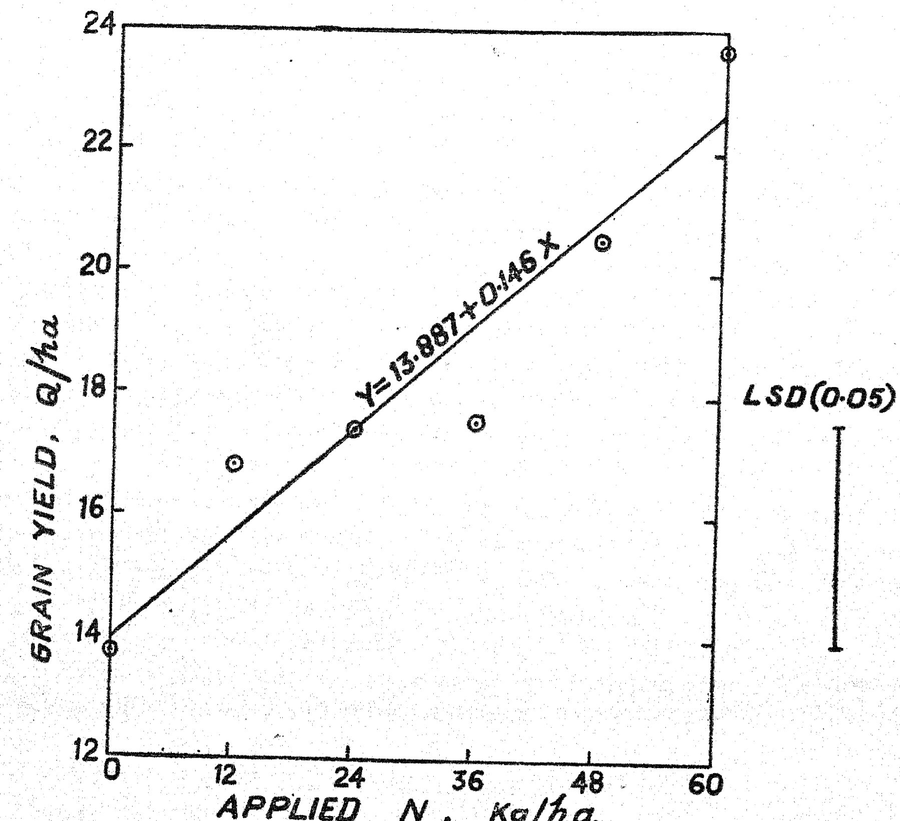

FIG.1: EFFECT OF DIFFERENT LEVELS OF N ON THE YIELD OF WHEAT GRAIN

TABLE 1: *Mean square values for grain yield and components of yield.*

	Grain yield q/ha	Plant density per metre	Grain yield per plant, g.	Ear-bearing shoots per plant	No. of grains per ear	1000-grain weight, g.
Nitrogen ..	11.18**	267.53**	14.48*	1.57	65.48	51.76
Phosphorus ..	1.02	1170.58**	15.02*	4.8**	223.54**	44.86
N × P ..	2.56	56.79	0.76	0.20	8.13	40.04

*,**Significant at the 5 and 1% levels of probability respectively.

TABLE 2. *Effect of N on grain yield and components of yield.*

Applied N Kg/ha	Grain yield q/ha	Plant density per metre	Grain yield per plant, g.	Ear-bearing shoots per plant	No. of grains per ear	1000-grain weight, g.
0	13.7	52.8	4.5	4.1	27.2	42.9
12	16.8	53.4	4.7	4.3	29.5	43.3
24	17.4	53.5	4.7	4.3	29.7	44.1
36	17.5	57.0	5.0	4.3	29.8	44.8
48	20.5	59.4	6.8	4.9	32.7	46.1
60	23.7	65.0	6.8	5.2	33.6	48.5
S Em ±	1.3	1.5	0.5	0.3	1.7	1.8
LSD 5%	3.6	4.5	1.5	..	..	..

TABLE 3. *Effect of P on grain yield and components of yield.*

Applied P, Kg/ha	Grain yield q/ha	Plant density per metre	Grain yield per plant, g.	Ear-bearing shoots per plant	No of grains per ear	1000-grain weight, g.
0	17.8	47.5	4.5	4.0	26.1	43.1
24	17.9	53.5	4.9	4.3	29.7	44.6
48	17.8	60.4	5.9	4.6	31.2	45.2
72	19.5	66.0	6.5	5.1	34.6	46.9
SEm ±	1.0	1.2	0.4	0.2	1.4	1.5
LSD 5%	..	3.6	1.2	0.6	4.1	..

TABLE 4. *Mean square values for straw yield and yield components.*

	Straw yield q/ha	Straw yield per plant, g.	Total shoots per plant	Plant height, cm.
Nitrogen ..	15.10**	43.03*	2.04	220.58*
Phosphorus ..	5.91	35.90	4.04**	413.16*
N × P ..	14.71	1.58	0.11	9.43

*,**Significant at the 4 and 1% levels of probability respectively.

TABLE 5. *Effect of N on straw yield and components of yield.*

Applied N, Kg/ha	Straw yield q/ha	Plant density/ metre	Straw yield per plant, g.	Total shoots per plant	Plant height, cm.
0	31.3	52.8	8.4	4.1	107.9
12	34.0	53.4	9.8	4.3	108.7
24	42.1	53.5	9.9	4.3	108.8
36	43.4	57.0	10.1	4.3	114.5
48	55.1	59.4	12.6	4.9	115.0
60	64.4	65.0	13.4	5.2	118.2
SEM ±	3.2	1.5	1.1	0.3	2.2
LSD 5%	9.2	4.5	3.0	..	6.2

TABLE 6. *Effect of P on straw yield and components of yield.*

Applied P, Kg/ha	Straw yield q/ha	Plant density/ metre	Straw yield per plant, g.	Total shoots per plant	Plant height, cm.
0	43.9	47.5	9.3	4.0	106.5
24	44.1	53.4	9.9	4.3	110.8
48	44.1	60.4	11.2	4.6	113.3
72	48.1	66.0	12.5	5.1	118.0
S Em ±	2.6	1.2	0.9	0.2	1.8
LSD 5%	..	3.6	..	0.6	5.1

TABLE 7. *Response curve of nitrogen.*

Due to	d.f.	S.S.	M.S.	V. ratio.
Nitrogen ..	5	55.92	11.18	
Linear ..	1	50.96	50.96	34.20**
Quadratic ..	1	1.09	1.09	0.63
Rest ..	3	3.87	1.29	0.87
Error ..	46	68.63	1.49	

**Significant at the 1% level of probability.

TABLE 8. *Mean square values for grain protein percentage.*

Nitrogen	Phosphorus	N × P
5.91**	0.44**	0.05

**Significant at the 1% level of probability.

TABLE 9. *Effect of N on grain protein percentage.*

Applied N, Kg/ha					
0	12	24	36	48	60
9.81	10.01	10.12	10.31	10.81	11.71
S Em ± 0.09	..	..	..	LSD (0.05)	0.26

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TABLE 10. *Effect of P on grain protein percentage.*

Applied P, Kg/ha.			
0	24	48	72
10.65	10.52	10.39	10.29
S Em ± 0.07	..	..	LSD (0.05) 0.21

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Effect of Minimum Tillage on Soil and Water Conservation

K. C. Das*

Minimum tillage may be defined as the least possible manipulation of the soil for satisfactory planting, germination, stands, growth and yields of a crop.

Acceptance of this reduced tillage practice has been largely based on decreased cost of operation, although various other desirable features have been advanced. The concept of minimum tillage can be carried so far as to include plowing and planting in one operation. This assumes of course, that condiitons are such that a good plowing job is possible.

Minimum tillage is desirable from the standpoint of erosion and runoff control, because of large aggregates or clod size and decreased compaction. It may not be easy to define, achieve and maintain optimum physical conditions for crop production. From the standpoint of soil and water conservation, however it is known that dry, pulverized soils can be eroded by wind, and that overworked or compacted soils, particularly those with a low degree of water stability to water erosion and drainage problems.

It is obvious that tillage is the basic cause of soil erosion, because it demands the removal of vegetative cover that is nature protects the soil. To a large extent the kind of farming done, determines the kind and number of tillage operation the time they are perfomed, and the extent to which the soil is protected by cover and incorporated organic matter.

The effect of tillage upon erosion is a function of its effect upon such factors as aggregation, surface sealing, infiltration, and resistance to wind movement.

Most methods of tillage decrease the size of aggregates and encourage the oxidation of organic matter, which means a loss of bacterial food and a decrease of aggregate binding material. This makes the soil more detachable, more transportable and hence more erodible.

The direction of tillage is of primary importance. Plowing up and down the slope leaves natural channels that collect rainfall and speed the run off water downhill with its load of soil. Tillage directed across the slope, on the contrary, provides a series of obstructions to the flow of water and innumerable pockets and depressions in which it is held until a greater portion of the water can enter the soil. If we exclude contour tillage, tillage as such is of little direct advantage in soil conservation.

Crop Requirements:

When the seedbed is being prepared for seeds to be germinated and grown in place as contrasted with set plants, the kind of seedbed needed will obviously be detemined to some extent by the seed size. Difference in requirements with respect to seed size are generally recognized. It is probably be easier to consider the seedbed in terms of the size and compaction status of the solid phase—the soil separates rather than in terms of porosity and the gaseous and liquid phases.

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Yoder studying seedbeds for cotton comprised of various starting combinations of soil separates from less than 1/16 into greater that 4 in size, reported satisfactory emergence and best growth with separates 1/8 to 1/4 in size. Results with the 1/4 to 1/2 in size were nearly the same. Yields resulting from the use of separates less than 1/16 in were less than half of maximum.

Some degree of compactness below the surface may be desirable in order that seedlings have a floor to push against. Other benefits of moderate compaction are an increased capacity for shortage of available moisture, a more rapid movement of moisture by capillarity and better transfer of moisture from the soil to the seed. The relation of excessive compaction to plant growth is not so well defined as its relation to drainage, erosion, and runoff. Size of structural units and state of compaction and moisture can be changed by tillage to influence soil temperatures.

Weed Control Requirements:

Chemicals have been successfully substituted for tillage in preparing seedbeds for pasture renovation or seedling and also for tillage for corn. This practice may be feasible for certain soils and crops. Claims of corn yields of from 70 to 100 bushels per acre without any tillage—except for a narrow slit to get the seed in and covered—cannot be disregarded it, one is considering minimum tillage. Weed control by herbicides is being widely used as a complete or partial substitute for cultivation. Generally crusting, is such that all cultivation cannot be eliminated without some sacrifice of yields.

Soil and Water Conservation Requirements:

The size of clods and aggregates their stability and state of compaction affect infiltration, permeability,susceptibility to movement by wind and water and moisture relations. Rai *et al.* reported data showing that between size limits of 4 mm. and 0.5 mm. a decrease in size by one half increased erosion by a factor of 2. Below 0.5 mm. the factor was about 5. Wilson and Browning reported that the amount of erosion on Marshall silt loam was inversely related to the percentage of aggregates greater than 2 mm.

On the Mardin soil, yields of corn were reduced about 6 per acre by three fitting operations. Much of the prevailing secondary seedbed preparation appeared to be not only wasteful of time and power but actually harmful from the standpoint of corn yields on the Mardin soil.

It is to be remembered that the temperature difference in soil lie in porosity, moisture and roughness relationships as influenced by fitting and compaction. To what extent they are a function of moisture, or possibly a determinant of moisture, is still under study.

Various methods of minimum tillage for raw crops have been proposed. Each is based on one or more particular advantages such as less cost for adapting equipment, fewer trips across the field and a better resulting seed bed.

In an experiment with six tillage implements which were selcted for comparison are:

(*a*) Conventional (plow, two diskings with trailing harrow, plant); two cultivations.

(*b*) plow plant without smoothing, no cultivation.

(*c*) plow plant with smoothing; no cultivation.

(*d*) plow plant with smoothing; two cultivations.

(*e*) plow without smoothing, wheel track planting, no cultivation.

(*f*) plow without smoothing, wheel track planting, two cultivations.

The equipment used for applying the minimum tillage treatments were (*a*) plow plant without smoothing, (*b*) wheel track planting.

No evidence of important differences between the various minimum tillage methods was found in this initial year of study. However important differences were found to between the convention and minimum tillage treatment and between the cultivated and uncultivated treatments.

The amount and rate of infiltration were much higher for the minimum tillage treatments than for the conventional treatments during all runs. This is attributed to the less compact, more rough and more open condition of the relatively undisturbed furrow slices of the minimum tillage treatments.

Minimum tillage with cultivation very significantly increased the amount and rate of infiltration and decreased the soil loss as compared to conventional tillage with cultivation.

No important differences in infiltration and soil loss were found among the three types of minimum tillage studied during the initial year.

Minimum tillage grs. conventional tillage

The soil loss from minimum tillage treatments was 35 to 50 per cent less than loss from the conventional treatment. The lasting values of minimum tillage after meadow in decreasing soil bulk density was shown by measurements which cannot be ignored. Samples were obtained at a 2 to 4 inch depth between corn rows. Bulk density averaged 1.18 gm. per cc. for the minimum tillage treatments and 1.49 gm. per cc. for the conventional treatment. The advantages of Minimum tillage can be stated here as follows:

1. Improves Soil Structure

Research indicates that many farmers are working their soil more than is necessary. They build up organic matter to improve soil structure, then destroy that structure by excessive working of the soil. Repeated tillage tends to compact the soil, thus restricting aeration and internal movement.

2. Cuts fuel and labour costs

Farmers using the wheel-track planting method have saved at least 3 to 5 dollars per acre in Michigan. Completing corn planting on time may result in an even bigger saving. Rain often delays planting several days when conventional tillage is used to prepare seed bed with wheel track and plow-plant methods, the corn is planted the first day the tractor can work in the field.

3. Gets the jump on weeds

Immediate planting after plowing makes weed control easier. A fine, firm seedbed for the corn is also a fine sedbed for weeds. And the weeds are busily sprouting before corn is planted. Corn put in the ground right after plowing comes up quickly. With the help of a starter fertilizer, it has a head start on the weeds. Because the corn gets a jump on the weeds, the first cultivation can be delayed for 3 or 4 weeks. Then the soil can really be thrown up around the corn.

4. *Lets soil soak up hard rains.*

In wheel-track planting trials at the La Cross Branch Experiment Station in Winconsin, a heavy rain fell 4 days after the corn was in and again 2 days after. Although no runoff measurements were made, there was little evidence of erosion on rough-plowed plots. On plots worked three times before planting, however there were many rills. With minimum tillage, the soil remains "open" and can take in moisture faster, thus reducing runoff.

5. *Increases yields and per acre return*

Dairy farmer Louis Brux of Juneau country, Wis., proved that good corn yield can be obtained in the Badger State with wheel-track planting. His corn field averaged 124 bushels per acre in 1954 and 106 bushels per acre in 1955,—an especially dry crop season for the area.

"I used to disk the newly plowed sod about 4 times before planting," says Burx. "Now I get a field plowed and planted all in one day. Quite often, the field will be planted within an hour after it is plowed." "Cutting out the disking operation has meant shortening Burx's spring work shedule by 3 days.

6. *Cuts soil and water losses*

Big advantages of minimum tillage may be conservation of soil and water. Many farmer note the improved condition of soil after using minimum tillage methods a couple of years. Soil Compaction-looseness of soil is the thing they notice, and the reason is obvious. Fewer trips with machinery means less compaction. Minimum tillage disturbs the plowed soil as little as possible, leaving large soil particles and soil pore spaces to soak up water. Seedbeds prepared by Conventional tillage methods may leave the soil pulverized, and the fine particles wash in and plug up pore spaces. Water then is forced to run off.

Till-Plant System

The till-plant method is a system of minimum tillage which consists of the following essential field operation.

(*a*) Cut stalks.

(*b*) Plant—In one operation till and plant in old ridge, apply insecticide, herbicide and starter fertilizer when needed.

(*c*) Cultivate—Cultivate the first time when corn is 10 to 16 inches tall. Use two sets of disk hillers in front of sweeps or furrowers in the year.

(*d*) Harvest—Conventional harvesting equipment is used.

It was found that tillage costs are less for the till plant system (7.50 dollars less per acre) compared to Conventional method.

The advantages of till plant system is same as discussed before.

Disadvantages of Till-Plant system

1. Yields may be reduced if crop is not properly managed.
2. Sight of trashy field condition may be objectionable.
3. Adjustment of equipment is more critical than for Conventional tillage.
4. Winter annual weeds may need to be sprayed prior to cutting stalks.

Tillage plays an important part in the management of crop residues for erosion control. It has been found by tests that these residues left on or near the surface save more soil than

when plowed into the deeper layers. Sub-surface tillage implements are being developed and put into use. These implements enable the farmer to prepare suitable seedbeds, control weeds, and at the same time to keep the dead plant material on the surface to protect the soil from sheet erosion.

To achieve the main purpose of tillage and at the same time conserve the soil, the following suggestions are offered:

CONCLUSION

(*a*) Till no more than necessary.
(*b*) Till only when the soil moisture is in the favourable intermediate range.
(*c*) Use chemical weed killers where practical.
(*d*) Plow erodible soils in the spring.
(*e*) Vary the depth of plowing.

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Effect of Maleic Hydrazide on Growth and Development of Pea (*Psium sativum* Lin.)

By B. P. Singh[1] and O. S. Jauhari[2]

Maleic hydrazide is one of the growth regulators which checks the apical dominance (11), encourages the growth of laterals (12), and modifies the flowering (8) and fruiting (1) behaviour. Mechanical pinching has the same mechanism of action to check the terminal growth but it is a great threat for the spread of virus, fungus, and bacterial diseases which can be avoided by the use of maleic hydrazide (MH).

It was therefore, deemed desirable to study the effect of checking the apical dominance with the help of MH in Pea Crop (*Psium sativum*). By accomplishing the check at the apex, it may be possible to encourage the number and growth of laterals and subsequently the yield.

Therefore, a field trial at Botanic gardens, Government Agriculture College, Kanpur was carried out to investigate the effect of MH on growth, development, size and yield of Pea (Var. T. 19).

MATERIALS AND METHODS

A randomized block design of lay-out was fallowed. For the experiment, five treatments (0, 100, 200, 400 and 800 ppm) were replicated 4 times. Seeds were sown on well-prepared land. Thirty days after seeding, 10 uniform seedlings per plot were selected and sprayed with the help of automizer according to allotted treatments. Polythene sheets were spread under the plant at the time of spray so that MH solution does not reach the rootzone of the plants.

The treated plants were kept under observation for height and diameter of main stem, number and length of laterals, flowering, fruiting, and quality of pods.

OBSERVATIONS

The data were recorded weekly on various growth and yield phases.

A. Vegetative Growth

Height and diameter of main stem, number length, and diameter of laterals were recorded at the interval of one week. Data are in table 1.

Table 1. *Influence of Maleic Hydrazide on Vegetative Growth of Pea.*

Observations	Treatments				
	0	100	200	400	800 ppm
1. Average Height of stem (Cm) ..	85.2	69.40	63.80	59.90	36.80
2. Diameter of stem (Cm) ..	0.71	0.62	0.60	0.57	0.48
3. Average Number of laterals ..	3.00	5.0	4.00	3.00	2.00
4. Average length of laterals (Cm) ..	66.20	68.3	59.70	50.40	24.60
5. Average diameter of laterals (Cm) ..	0.62	0.63	0.57	0.54	0.36

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2. Department of Horticulture, Govt. Agriculture College, Kanpur.

Data from Table 1 revealed that MH influenced the vegetative growth considerably. Height and diameter of main stem, length and diameter of laterals were inhibited significantly by MH spray. MH (100 ppm) encouraged the number and length of laterals.

B. Flowering and Fruiting

Data recorded on flowering and fruiting in different treatments revealed that apart from its inhibiting effect on vegetative growth, MH showed a marked effect on flowering, fruiting, maturity, fruit set, length and diameter of pods per plant and yield. Data are in table 2.

TABLE 2. *Influence of Maleic Hydrazide on Flowering and Fruiting of Pea.*

Observations	Treatments				
	0	100	200	400	800 ppm
1. Number of Days for Flowering ..	49	51	53	53	56
2. ,, ,, ,, ,, Fruiting ..	55	59	61	62	67
3. ,, ,, ,, ,, Maturity ..	71	74	76	80	86
4. Percentage of Fruit Set ..	86	78	72	64	52
5. Average length of Pod (Cm) ..	6.6	5.8	5.9	5.3	4.9
6. Average Diameter of Pod (Cm) ..	1.25	1.20	1.40	1.35	1.18
7. Average Number of Pods per plant ..	12.25	10.75	8.75	8.00	3.00
8. Average yield per plant (Gm) ..	73.89	54.95	45.42	34.32	11.45
9. Per cent Dry Weight ..	20.40	20.90	20.80	21.2	20.60
10. ,, Water ..	79.60	79.10	79.20	78.8	79.40

Flowering, fruiting and maturity periods were delayed by MH treatment. MH decreased the fruit set significantly. Only 52% fruit set was recorded in plants treated with 800 ppm MH as compared to untreated plants which set the fruit about 86%. Number of pods per plant, length and diameter of pod were decreased significantly. This reduction in number and size of pods influenced the yield per plant per acre.

MH did not influence the quality of pods as evident by the non-significant changes in fresh and dry weight of pods.

DISCUSSION

The inhibition in length and diameter of laterals is in line with the results obtained by Greulach (5). Greulach and Atchinson (6) are of opinion that inhibition is due to suppression in cell division. Naylor and Davis (11) remarked that MH is an anti-auxin and brings the cessation of internodal elongation and removes the dominance from apical meristem. The rate of inhibition was increased with the higher concentrations which is in confirmity with the findings of Lana (9).

Plants treated with 100 ppm concentration produced the maximum numberof laterals of larger length and diameter, while the average number of laterals was lowered with the higher concentrations. This suggests that low concentration encourages the number of laterals while higher concentrations decrease the number. Similar findings were reported by Paterson (12) who suggested that the release of axillary buds from spical dominance which ultimately increases the number may be due to an alteration in the rate at which auxin is supplied to the axillary buds.

MH delayed the flowering time. Similar delayed flowering was observed by David and Wayne (4). Klein and Leepold (8) suggested that delay in flowering may be due to the influence of MH on floral primordia. Cifferri (2) explained this phenomenon in terms of lowered level of carbohydrates reserves and the effect of C/N ratio. Appearance of first pod and its maturity period was also delayed. Similarly Bordey and Fraus (1) noted delayed maturity in asparagas.

It is interesting to speculate on the role of MH in the control of fruit set. Higher concentration (800) ppm decreased the fruit set to an extent of 52% as compared to control (86%). This decreased percentage of fruit set may be due to decreased auxin content as observed by Chowdhery and Bhatnagar (3) in radish.

Application of MH decreased the number and size of pods per plant. This observation is similar to findings of Chowdhery and Bhatnagar (3) who reported reduction and abnormality in the shape. Reduction in the yield is similar to the report of Josephson (7) who suggested that any concentration which delays flowering is responsible for decreased yield.

There was no significant influence in the total solids and moisture percentage which is determining factor for the quality of fruits from treated and untreated plants. The same effect was reported by Wittwer and Hansen (13).

An intensification of green and chlorosis in leaves was observed in stunted plants under 800 ppm which were also observed by Moore and Rujus (10).

It is thus inferred that a lower MH concentration may prove of material advantage in augmenting the growth, flowering and yield in peas.

SUMMARY

There was a great inhibition in height of plant, diameter of main stem, time of flowering, fruit setting, appearance of first pod, time of maturity, yield and size of pods with higher concentrations (200, 400 and 800 ppm) which suggested that control was better than treated ones. The number, diameter and length of laterals were increased under 100 ppm as compared to control.

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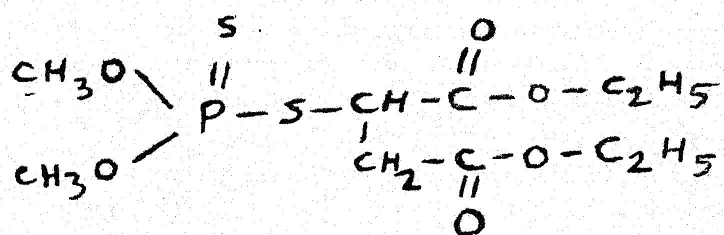
Malathion for Disinfestation in Warehouses

P. M. Thomas*

Malathion is a powerful, versatile and safe phosphatic insecticide and is the common name for the chemical 0, 0 dimethyl phosphorodithioate diethyl mercaptosuccinate, variously referred to as compound 4049; Malathion; 2'(1, 2 dicarbethoxyethyl) 0, 0 dimethyl phosphate, 2-1:2 (ethoxycarbonyl) ethyl dimethyl phosphorothiol thionate, 0-0 dimethyl S (1, 2-bis-(ethoxycarbonyl)-ethyl) phosphorodithioate and currently defined as S (1-2-bis ethoxycarbonyl) ethyl 0-0 dimethyl phosphorodithioate.

The accepted structural formula of the insecticide is:



and emperical formula is $C_{10} H_{19} O_6 PS_2$ having molecular weight of 330.4. Its specific gravity is 1.2315 at 25°C and weight per gallon is 10.25 pounds.

2. **History**

The insecticidal property of malathion was first announced by the American Cyanamid Company in December, 1950. The company claimed it to be much less toxic to mice and rats than parathion. This claim has been largely substantiated, and malathion now enjoys use as a safe insecticide.

3. **Properties**

Malathion is in liquid form and has high boiling point at 156°-157°C under 0.7 mm pressure with slight decomposition. It is deep brown to yellow in colour, slightly soluble (approximately 145 ppm at 25°C) in water, very slightly soluable in paraffinic solvents, limited solubility in petroleum oils, but completely soluble in many organic solvents, (e.g. alcohols, esters, ethers, aromatic hydrocarbons), ketones and vegetable oils. Chemically, malathion is stable in water at pH 7 or below, but is readily hydrolyzed in alkaline solutions. Malathion is relatively nonvolatile. Pure malathion has no unpleasant odour but the commercial product containing 95 per cent active ingredient is brown to yellow liquid and has a markedly unpleasant odour like mercaptan which slowly disappears. A "premium grade" product with a much less marked odour is also commercially available for use in warehouses as well as for indoor usage against pests of household and public health.

Malathion has no adverse effect on the germinating quality of grains when mixed upto 250 ppm and held in storage at either high or low humidity. The malathion poisoning symptoms to rats, mice and other vertebrates are almost alike to those caused by other organophosphorus insecticides and are characteristic of the anticholinesterase activity. The symptoms appear to be for short period and complete recovery is possible unless death occurs within a few hours.

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The death is caused by difficult respiration and suffocation but convulsion is possible with the highest doses. Although the malathion poisoning is characteristic of anticholinesterase activity but the pure malathion is not itself anticholinesterase, rather it is converted to an active anticholinesterase by the animal.

However, the use of malathion may be hazardous with other organophosphorus insecticides specially with EPN as there is considerable potentiation or greater than additive effect but the effect is additive with systox, parathion or methyl parathion.

The malathion toxicity increases with the rise in temperature. Malathion is stable for an indefinite period if properly stored but decomposition takes place at the temperature much above the room temperature and readily hydrolyses in highly alkaline or mildly acidic media. The product attacks iron, steel, terne plate, tin plate, lead and copper; the last two very seriously. Both malathion and its liquid formulations gels when these are stored for long periods in the presence of iron. Therefore it is very necessary that all interior of metal containers should be suitably lined with resistant lacquer. Dilute emulsions of malathion are stable over long periods.

Malathion leaves no hazardous chemical residues, off flavour, or colour on the treated commodities nor it has been found to affect the milling and backing quality.

It has a low dermal toxicity, safe in its operation and has a low acute oral toxicity to mammals.

Malathion possesses high insecticidal properties but produces a weak inhibition of tissue cholinesterase. The toxicity of malathion insecticide to humans and animals is far less than that of many other synthetic organic insecticides. It is reported to be the safest of the organic phosphorus insecticides, the acute oral toxicity being 1/100 to 1/300 as toxic as parathion to laboratory animals.

Malathion is even more safe than DDT, BHC, lindane, chlordane, aldrin, dieldrin, endrin, parathion and other pesticides. The toxicity of pesticides is measured by their LD_{50} value which is generally expressed in mg/kg body weight, administered in a specific manner to a particular test animals.

Higher the LD_{50} value safer the insecticide to handle. Following are the acute oral LD_{50} values of some common pesticides for white rats.

Insecticides	LD_{50} values (mg/kg body weight) Acute oral, Rats
DDT	113-250
BHC	150
Lindane	125-200
Chlordane	335-590
Parathion	3
Pyrethrins	200
Nicotine	50-60
Malathion	1000-1500
Endrin	7.5-28.8
Dieldrin	87
Aldrin	40

The insecticidal property of the malathion can protect stored products and their derivatives when mixed for three to twelve months or more from the insect damage depending upon the climatic and storage conditions. In the temperate zone, a single treatment of this insecticide can protect grain at least for one storage season provided these are treated before received in storage. For longer storage, grains require re-treatment.

The length of residual protection provided by this insecticide is influenced by the temperature and moisture content of the stored products. Chemical analysis shows that this insecticide has a biological half life of approximately 5-6 months on grains having 12 per cent moisture at 24°C. The adverse effects of the high temperature and humidity can be practically overcome by increasing the dosage of the insecticide. But the actual performance under local conditions can be determined by the insect pests to be controlled and by the local storage and mode of application.

4. Toxicity to Insects

Malathion is highly toxic to adults of *Oryzaephilus surinamensis*, *Tribolium castaneum*, *Sitophilus* spp. *Ephestia* sp. but less effective against adults of *Lasioderma sericorne*, *Rhizopertha dominica* and larvae of *Ephestia* spp. *Stegobium panicaeum* and *Trogoderma granarium*. Both adults and larvae of *Plodia interpunctella* are highly susceptible to malathion.

Malathion is reported to be highly toxic to mites and a number of insect species attacking crops, animals and humans.

It can be applied effectively to a variety of grains and seeds like wheat, rice, paddy, rye, oats, corn, maize, barley, sorghum, millets, groundnut, beans etc. It can be applied both in bulk and bagged storage structures against a variety of insect pests.

Malathion has no insect repellent property and the moisture content of grains has an important influence on its effectiveness. A complete kill is obtained at each concentration of 2, 4, 8, 16 ppm. When the wheat moisture content was 13.5 per cent and the tests were made either two or five months after treatment. Higher the moisture content the greater the ppm required for complete protection. The residues are removed in screening and no harmful residues are left in bran, suji or flour after milling. Malathion-treated grains can safely be stored for longer periods depending upon storage conditions.

5. Dosage

Malathion may be available in the form of dust and 50% concentrate emulsion. The filler used in 5% malathion dust is pyrophyllite of 200 mesh.

The detailed use of malathion for prophylactic treatment is indicated hereunder:

Dust: (*i*) 0.250 kgs. per 10 sq. meters of surface area.

(*ii*) 0.120 kgs. per 10 sq. meters of vacant area.

Spray: Malathion (premium grade) 50% concentrate emulsion is used with water in the ratio of 1:300.

(*i*) *Surface treatment:* 3 liters per 100 sq. meter at an interval of 3 weeks.

(*ii*) *Air Charging:* 1 liter per 300 cu. meters at an interval of not less than seven days (2-3 weeks)

(*iii*) *Walls/Alleyways:* 3 liters per 100 sq. meters once a week in order to control crawling insects and avoid cross infestation

(*a*) Fumigation of stock infested with *Tribolium* and *Oryzaephylus* may not be done when malathion spray is used as it is very efficacious against these pests.

(*b*) When malathion spray is used in the warehouses Gamma BHC (Lindane) dusting can be dispensed with.

(*c*) Direct contact of the insecticide with (naked) grain and milled product must be avoided. There is no harm to give a light spray to surface of bags containing milled product.

(*d*) Recommendations in Great Britain concerning use of malathion for control of stored products pests state that there should be no hazard to consumers provided (*a*) the amount admixed with small grains or oil seeds does not exceed 10 oz. per bushel (approximately 10 p.p.m. for wheat), (*b*) the amount added to the surface of bulk grain or oil seed does not exceed 5 oz. per 1000 square feet of surface, and (*c*) the amount deposited on the surface of stacks of grain or oil seeds in closely woven bags does not exceed 114 mg. per square foot of surface. Malathion is also permitted for treatment of walls and surfaces of empty storage rooms, wagons, and storage bins and for the surface of stacks of foodstuffs in woven or fiber containers.

NOTE: Sweepings/Spillage collected in sheds/godowns where malathion dust/emulsion is used for prophylactic treatment, the stocks may also be cleaned and disposed of in the manner already advised as in the case of Lindane.

6. **Caution**

Malathion itself is not flammable. However, its liquid formulations may be flammable on account of the solvents used.

(*a*) Malathion is toxic and harmful if swallowed. Avoid contamination of foodstuffs and animal feeds and inhalation of mists made from this insecticide.

(*b*) Repeated or prolonged exposures to its formulations should be avoided.

(*c*) If it comes in contact with skin, wash with soap and water.

(*d*) Contaminated clothings should be washed with soap and water before reused.

(*e*) Do not use this container for any other purpose except for storage of pesticides.

(*f*) Keep out of reach of children and domestic animals.

(*g*) If poisoning occurs, call a physician. Atropine and oxygen are useful in treatment.

Drums containing malathion should be kept tightly closed when not in use. When drums are empty, the gasketed bungs should be securely replaced. Any spillage on the outside surface of the drum should be hosed off with water.

7. **Nature of Poisoning and Treatment**

Malathion insecticide is one of the organo-phosphotic insecticide and is only slightly toxic to mammals. Exposures to high concentration of malathion for long period, like any other organic phosphate insecticide, leads to cholinesterase inhibition within the body. Cholinesterase hydrolyses the Acetyl Choline. All Organo-phosphorus insecticide inhibit this enzyme, Cholinesterase. Cholinesterase inhibition can be detected from a blood sample of the man who has been poisoned with malathion. The common symptoms of malathion poison-

ing are lacrimation, salivation, laboured breathing, marked tremors, vomiting, diarrhoea and convulsions. All these symptoms are typical to any of the phosphate ester insecticide.

8. First Aid Measures

The chances of poisoning can be reduced provided the insecticide is handled carefully with due precautions. If malathion poisoning is detected, immediately call a physician. In the meantime, give the patient one to two tablets of atropine grains 1/100, which can be repeated after an hour, if necessary. If the insecticide is swallowed, induce vomiting by giving warm salty or soapy water. If skin contamination occurs, remove the contaminated clothing and wash the skin thoroughly with copious quantities of soap and water to remove all traces of malathion insecticide.

9. Medical Supervision

Even though malathion is less toxic to human, the use and properties of this insecticide be intimated to the physician so that he may be able to diagnose and treat the poisoning symptoms correctly. The operator be medically examined at the periodic interval.

In cases of poisoning, the physicians may consider the principles given as under:

(*a*) Artificial respiration preferably by mechanical means.

(*b*) Atropine, 2 mg. intravenously as soon as cyanosis is overcome. Repeat at 5 to 10 minutes interval until signs of atropinization appear (dry flushed skin and tachycardia as high as 140 per minute).

(*c*) Decontaminate the skin or empty the stomach.

(*d*) Treat symptomatically.

In the more usual case, proceed as follow:

Keep the patient fully atropinized if symptoms appear. Give 1 to 2 mg. (1/60 to 1/30 grain) atropine sulphate every hour up to 10 to 20 mg. in a day, particularly for the control of respiratory symptoms. The intravenous route is most rapid. It will be noted that this dosage of atropine is greater than that conventionally employed for other purposes but is within safe limits. Atropine relieves many of the distressing symptoms, reduces heart block, and dries secretions of the respiratory tract.

People poisoned by anticholinesterase organic phosphorus compounds have an increased tolerance for atropine. Furthermore, a single dose of as such as 10 mg. of atropine has been inadvertantly administered intravenously to normal adults without endangering life, although it has, of course, produced very marked signs of over dosage. In the presence of severe anticholinesterase poisoning, 24 mg of atropine may be given in a day without producing symptoms attributable to atropine. The effects of intravenous atropine begin in 1 to 4 minutes and are maximum withn 8 minutes. A mild degree of atropinization should be maintained in all cases for 24 hours, and in severe cases for at least 48 hours.

Never give, morphine, theophylline, or theophylline-ethylenediamine (Aminophylline). Do not give atropine to a cyanotic patient; give artificial respiration first and then give atropine. Intravenous fluids are generally contraindicated because of excessive fluid in the respiratory tract.

If pulmonary secretions have accumulated before atropine has become effective, postural drainage should be used in order to improve ventilation. Use suction and a catheter if necessary. If the stomach is distended, empty it with a Levine tube.

If the patient has not yet shown symptoms or they have been allayed by the first dose of atropine, he must be completely and quickly decontaminated. Wearing rubber gloves, remove the patient's clothing and with due regard for his condition at the moment, bathe him thoroughly with soap and water. If washing soda or baking soda is available, use it, for organic phosphorus compounds are hydrolyzed more rapidly in the presence of alkali. Any relatively mild alkali may be used.

If there is any suspicion that the poison has been ingested and if the patient is still responsive, induce vomiting, give some neutral material such as milk or water, and induce vomiting again. Nausea may be anticipated, of course, on the basis of the systemic action of these compounds, but if vomiting is not profuse, gastric lavage may be used.

Atropine does not protect against muscular weakness. The mechanism of death appears to be respiratory failure. The use of an oxygen tent or even the use of oxygen under slight positive pressure is advisable and should be started early. Watch the patient constantly, since the need of artificial respiration may appear suddenly. Equipment for oxygen therapy and for artificial respiration should be placed by the patient's bed in readiness while the patient is on his way to the hospital. Cyanosis should be prevented by suitable means, since continued anexia aggravates the depression of the respiratory centre caused by the poison directly. Complete recovery may occur even after many hours of artificial respiration have been necessary.

The acute emergency lasts 24 to 48 hours, and the patient must be watched continuously during that time. Favourable response to one or more doses of atropine does not guarantee against sudden and fatal relapse. Medication must be continued during the entire emergency. Any person who is ill enough to receive a single dose of atropine should remain under medical observation for 24 hours, because the atropine may produce only a temporary relief of symptoms in what may prove to be a serious case of poisoning. Atropine should never be administered for preventive purpose to persons who have not become sick.

Chemical Composition of some Free-Stone Peaches before and after the Process of Canning

R. K. SRIVASTAVA[1] and R. P. SRIVASTAVA[2]

Peach is one of the important fruits of Kumaon as it comes next to apple in importance and has the second largest area under it. As stated by Cruess (2) in foreign countries a large quantity of peaches is canned than of any other single fruit. Its delicate flavour, which persists after canning, its firm texture, which withstands the drastic heat treatment of sterilization without disintegration, its attractive appearance, and moderate price have combined to give the peach its present popularity (2).

There seems to be less published matter available on the canning of peaches under Indian conditions. This study was, therefore, undertaken by the authors to assess the possibilities of canning some of the free-stone varieties grown at Chaubattia. The analysis of the important chemical constituents before (fresh fruits) and after canning (slices) was also associated to see the nutritive value of the fruits and the finished products.

MATERIALS AND METHODS

Three varieties of free-stone peaches grown at the Government Gardens, Chaubattia, *viz.*, Foster, Red Nectrine and Red Wing, were taken for the chemical estimations and canning trial.

Hundred fruits of each variety, uniform in size, colour, texture and maturity, were picked at random from trees uniform in age, vigour and productivity and a composite sampling was made. Estimations of T.S.S., pH, total acidity, ascorbic acid, sugar (reducing and non-reducing), were made as per method given in A.O.A.C. (1).

Five Kg of each variety of the fruits were cut by hand with stainless steel knives and the pits removed. The halves were kept in 2 per cent salt solution during the process of preparation, in order to avoid exidative browning. Thereafter the halves were lye peeled in 2 per cent Na OH solution. The prepared fruit was filled at the rate of 180 gm per can (butter can), 20 cans per variety. A syrup of 45° Brix containing 0.1 per cent citric acid was prepared and added to the cans boiling hot.

The cans were then exhausted at a temperature of 180° F for 10 minutes and sealed immediately with a domestic hand can sealer. After having sealed the cans were sterilized at the boiling point of water for 51 minutes, keeping in view the altitude of Ranikhet. The sterilized cans were immediately removed from the open cooker and cooled in running tap water.

RESULTS AND DISCUSSION

The results of the estimations of important chemical constituents of the 3 varieties indicate that Red Wing had the maximum soluble solids and reducing and total sugars, while variety Foster gave maximum pH value and acidity. Out of the 3 varieties Red Nectrine was observed to be the richest source of ascorbic acid and it had the maximum acid-sugar-ratio as well (Table 1).

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TABLE 1. *Showing the chemical composition of mature peach fruits.*

S. No.	Chemical constituents	Red Wing	Foster	Red Nectrine
1	T.S.S. °Brix ..	11.00	10.00	10.50
2	pH ..	3.50	4.00	3.50
3	1—Ascorbic acid (mg/100 gm) ..	7.40	5.20	9.80
4	Acidity (per cent) ..	0.51	0.62	0.46
5	Sugars: (per cent) (a) Reducing ..	3.00	2.80	2.00
	(b) Non-reducing ..	6.65	5.30	7.60
	(c) Total ..	10.00	8.50	10.00
6	Acid-sugar-ratio ..	1: 19. 6	1: 13. 7	1: 21. 7

The time required for complete peeling varied considerably and minimum time was taken by the variety Red Nectrine. The recovery of lye peeled halves was maximum under the variety Foster followed by Red Wing (Table 2).

TABLE 2. *Showing the time required for lye peeling and recovery of the peeled halves*

S. No.	Variety	Time required in lye peeling	Recovery of lye peeled halves (per eent)
1	Foster ..	1 Min. 45 Secs. ..	66.5
2	Red wing ..	1 Min. 15 Secs. ..	66.2
3	Red Nectrine ...	0 Min. 25 Secs. ..	62.0

The cans were cut open immediately after coolings and the observations have been presented in Table 3.

TABLE 3. *Showing the details regarding the cut out report*

S. No.	Observations	Variety		
		Foster	Red Wing	Red Nectrine
1	Gross weight of the can (gm) ..	649	645	655
2	Nett weight of content (gm) ..	552	545	555
3	Drained weight of slices (gm) ..	260	250	254
4	Syrup: (a) Clarity ..	Clear	Clear	Clear
	(b) Colour ..	Colourless	Colourless	Colourless
5	Slices: (a) Colour ..	Natural	Natural	Natural
	(b) Flavour ..	Disagreeable	Good	Good
6	Texture ..	Good	Good	Soft
7	Head space (cm) ..	1.56 (5/8″)	1.56	1.56
8	General remarks regarding acceptability and organoleptic test.	Due to its disagreeable flavour and sour taste the product is not acceptable.	The product is acceptable and the size of the pieces is small to medium.	The product is acceptable and the size of the pieces is medium.

The cans were opened after seven days of canning and the important chemical constituents of the slices of the 3 varieties were analysed. The estimations, revealed the fact that Red Nectrine peach maintained its superiority in having the maximum ascorbic acid and sugar content. While Foster was noticed to have more acidity. However, a general deterioration of the constituents except sugars was observed at this stage (Table 4).

TABLE 4. *Showing the chemical composition of slices after 7 days of canning*

S. No.	Chemical constituents		Red wing	Foster	Red Nectrine
1	1—Ascorbic acid (mg/100 gm)	...	1.96	3.10	3.30
2	Acidity (per cent)	...	0.37	0.57	0.32
3	Sugars per cent) (a) Reducing	...	14.40	12.60	15.90
	(b) Non-reducing	...	5.50	7.03	8.60
	(c) Total	...	20.20	20.20	25.00
4	Acid—sugar—ratio	...	1: 54.5	1: 35.0	1: 78.1

The peaches should retain their form,size, flavour, colour and aroma during sterilization in the can (2, 3). The pit should be small in order to give thick halves that do not flatten during heating. The fruits should also retain their flavour well or improve in flavour after canning. Some of them acquire a disagreeable flavour on heating, this being particularly true of some free-stone varieties (2).

In general, the firm, yellow, cling-stone varieties grown for canning possess the qualities enumerated above, whereas most of the free-stone varieties lack one or more of these desired characteristics. As per data available at hand pertaining to the varieties named above, the size of Foster meets the requirements, but the pit is too big in size and it develops disagreeable flavour after processing as such the product is not acceptable for commercial canning.

The size of Nectrine and Red Wing varieties is small to medium and medium respectively, therefore, only the better sized fruits of these varieties should be used on commercial lines. However, the size of these peaches can be greatly influenced by the horticultural practices like thinning, manuring etc. if required for commercial canning.

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SUMMARY

The fruit of 3 commercial varieties of peaches were analysed before and after the process of canning. Red Nectrine was observed to be the richest source of ascorbic acid and it had the maximum acid-sugar-ratio. The recovery of lye peeled halves was maximum under the variety Foster followed by Red Wing, but Red Nectrine took the minimum time in getting completely peeled.

The estimations after seven days of canning revealed the fact that Red Nectrine peach maintained its superiority in having the maximum ascorbic acid and sugar content. Out of the three varieties under study Red Nectrine and Red Wing can be used for commercial

canning. The size of Foster meets the requirements but it was rejected due to bigger pit and disagreeable flavour after processing.

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Effect of Phosphate and Molybdate on the Growth Characters of Russian Giant Cowpea—(*Vigna Sinensis*)[1]

R. M. Singh and T. C. Jain[2]

Production of high quality forage for ever-increasing population of cattle in India is a challenge to farmers on his limited land resources. Lack of irrigation facilities and scanty rainfall in Rajasthan, further aggravate this problem. This leaves no alternative but to grow a rich and high yielding forage—especially a legume which can be mixed with—Jowar or Bajra a common forage, to increase the palatability and quality of the roughage. Cowpea, a Russian Giant variety noted for its high yield and quality (Singh and Jain, 1964), being the only legume crop which meets this requirement without adversely affecting the use of land and its fertility for the very wanted rabi crop—wheat, on an irrigated area.

Phosphorus and molybdenum play an important role in increasing growth, yield and quality of legumes. They have direct influence on the growth and indirect by maintaining the rhizobial population. Robinson and Brossard (1957) reported that 20 ounces of molybdenum/ha produced highly significant yield and quality of leguminous hay and weight of root nodules. Stephans (1959) obtained the response of molybdenum on legumes and no response on non-leguminous crops. Shende and Sen (1958) reported that a combination of phosphorus and molybdenum has given better response than either of two alone. Anderson (1956) mentioned the use of "Molybdenum superphosphate" fertilizer for legumes. This fertilizer contained about 0.75Kg. of Nolybdenum trioxide ($M^0 0_3$) per metric tonne of superphosphate.

Practically no information, on the response of this variety of cowpea in terms of growth attributes to the application of phosphate and molybdate, was available in Udaipur region. It was, therefore, necessary to study its behaviour experimentally before it could be advocated for its wide cultivation and scientific manuring in this region to obtain the maximum advantage.

EXPERIMENTAL PROCEDURE

The experiment was conducted to investigate the effect of phosphate and molybdate on the growth of cowpea at Rajasthan College of Agriculture Farm, Udaipur in the Kharif season of 1961.

The soil of the experimental plot was sandy clay with the following physical and chemical composition:

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1. Contribution from the Department of Agronomy, R.C.A. Udaipur.
2. Professor of Agronomy and formerly M.Sc. student, now Research Scholar, Central Arid Zone Res. Institute, Jodhpur.

Physical Composition		*Chemical Composition*		
Fraction	*P.C.*	*Components*		*Per cent*
Coarse Sand	13.5	Organic Carbon		0.68
Fine Sand	31.7		Total	Available
Silt	13.6	N	0.062	0.011
Clay	31.6	P_2O_5	0.12	0.0016
pH 8.4		K_2O	0.40	0.0078

The experiment was laid out in a factorial design with randomised blocks in four replications. The treatments consisted of four levels of phosphorus and three levels of molybdenum singly and in combination.

Levels of P_2O_5		Levels of Molybdate	
P_0	0 Kg P_2O_5/ha	M_0	0 kg Molybdate
P_1	33.62 Kg/ha	M_1	1.12 Kg/ha
P_2	67.24 Kg/ha	M_2	2.24 Kg/ha
P_3	100.86 Kg/ha		

P_2O_5 was derived from Superphosphate and Molybdate from Ammonium molybdate.

Cowpea culture obtained from I.A.R.I., New Delhi was inoculated in the soil by mixing 1 tin of culture and 40 kg of dry sand after 18 days of seeding. The mixed culture was spread uniformly near the plants and mixed in the soil to a depth of 5 cm. Delayed inoculation was undertaken on the basis of results obtained by Dart (1959) and Nutman (1957). The observations were recorded at the age of 71 days after seeding.

EXPERIMENTAL RESULTS

Effect of Phosphorus

It is obvious from the data in Table 1 that plant characters viz. length of shoot, number of branches and number of leaves contributing towards dry matter production of plants have been beneficially affected by the application of phosphate, however, significant effects were observed only a number of branches and yield per plant (dry weight). Increasing levels of phosphate significantly increased the number of branches. Application of P_2O_5 at 100.86 Kg/ha significantly increased dry weight per plant, however, the differences between the effects of P_1 and P_2 were non-significant.

Formation of nodules on roots was significantly affected by the application of phosphate irrespective of levels. Maximum (significant) benefit was observed by the appliction of 67.24 Kg over 33.62 Kg/ha respectively.

Effect of phosphate on ratio of shoot to root was not appreciably noticeable.

Effect of Molybdate

Application of M_0 influenced significantly the number of branches (Table 2). Increasing levels increased branching significantly. Slight beneficial effects wer noted on number of leaves, dry weight of shoot, dry weight of roots and dry weight of nodules but the effects were non-significant. The length of shoots and shoot/Root ratio were slightly adversely affected.

TABLE 1. *Effect of Phosphorous on various growth characters*

Treatment	Length of Shoot (cm.)	No. of Branches/ Plant	No. of leaves/ plant	Dry weight (gm.)/ plant	Dry weight (gm) roots/ plant	Dry weight (gm.) nodules/ plant	Ratio Shoot/ Root
P_0	151.3	4.90	101.5	43.50	3.63	0.18	11.4
P_1	148.0	4.89	92.2	52.60	4.35	0.21	11.4
P_2	161.0	5.93	100.2	51.00	4.50	0.31	10.6
P_3	151.0	6.13	110.2	56.70	4.65	0.21	11.7
S. Em.	± 5.43	± 0.24	± 7.7	± 2.31	± 0.54	± 0.036	± 1.02
L. S. D. 5%	..	0.68	...	6.48	..	0.078	..

TABLE 2. *Effect of Molybdenum on Various Growth Characters*

Treatment	Length of Shoot (cm)	No. of Branches per plant	No. of leaves per plant	Dry Wt. (gm) Shoot per plant	Dry Wt. (gm) roots/ plant	Dry Wt. of Nodules (gm)/plant	Ratio Shoot/ Root
M_0	158.5	4.98	98.3	50.2	4.11	0.21	11.9
M_1	148.5	5.36	101.0	51.5	4.22	0.23	11.4
M_2	151.5	6.12	104.0	51.1	4.51	0.25	10.7
S. Em.	± 4.7	± 0.21	± 6.69	± 2.0	± 0.47	± 0.03	± 0.96
L. S. D. 5%	...	0.59	...	..	...	...	...

DISCUSSION

In increasing dry matter production in cowpea number of branches play a significant role, which was found to be significantly affected by increasing levels of phosphate upto 67.24 kg. P_2O_5/ha beyond which differences were negligible. This lead to significant increase in the dry matter production per plant. The increase in dry weight of shoot by application of P_2O_5 over no phosphate was in the order of over 16 per cent, while in case of roots increase was more than 20 per cent. Similar findings have been reported by Datta and Sharma (1960), where application of 80 lbs P_2O_5 per acre on legumes beneficially affected the branching and root development the most. Beneficial effects of P_2O_5 on legumes had been reported by Parr and Bose (1944, 1945, 1947). The effect of M_0 was more pronounced on roots than on shoots. As its application increased the dry weight of shoot by only 2 per cent whereas the roots by 10 per cent. The effects on nodulation was more pronounced by application of P_2O_5 than by M_0. The interaction showed that a combination of 67.24 kg P_2O_5 and 1.12 kg M_0/ha produced the maximum nodulation. The observations of Sen and Bains (1957), Evans (1956), Shende and Sen (1958), and Anderson (1956) confirmed the present findings.

Correlation studies showed that the dry weight of the plant was significantly correlated with the length of the shoot (r=0.94), and with the number of leaves (r=0.92). There was though a positive correlation between the dry weight of shoot and dry weight of root nodules (r=0.54), but non-significant. This finding is in agreement with the observations of Massiefield (1957) who reported that there was no definite trend of relationship.

SUMMARY AND CONCLUSION

The investigation titled "Effect of Phosphate and Molybdate on the growth of Cowpea (Russian Giant)" was carried out in the kharif season of 1961 on the College farm. The following conclusions were arrived at though they need further confirmations:

1. Application of P_2O_5 increased the number of branches, dry weight of shoot and dry weight of nodules per plant, however, other characters remained unaffected.
2. Application of M_0 affected the number of branches significantly, the rest of the characters were not affected. It proved more beneficial to roots than to shoots.
3. P_2O_5 at 33.62 kg and M_0 at 1.12 kg/ha in combination appeared to be beneficial.

ACKNOWLEDGEMENT

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Food Plant Study of Brinjal Lace Wing Bug (*Urentius Echinus* Dist.)

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Urentius echinus D. is a specific pest of brinjal (*Solanum melongena*). Very little work has so far been done on the food plants of this bug. Distant (1903) Lefroy (1909), Fletcher (1914), Pillai (1921), Jepson (1924), Patel and Kulkarni (1955), Wesley (1960), and several others have reported this pest occurring only on brinjal in different parts of India.

With a view to know the alternate host plants, a feeding trial was made in the laboratory where the bugs (adults and nymphs) were released on several solanaceous plants viz. *Solanum nigrum* (Makoy), *S. tuberosum* (Potato), *Nicotiana tabaccum* (Tobacco), *Capsicum anum*(Chilli) and *Lycopersicum esculentum* (Tomato). The trial was repeated with all the above mentioned plants but the pest failed to live on any one of them.

During the course of investigation in 1961-62 two solanaceous weeds known as *S. jasmonoids* (Kataiya) and *S. xanthocarpum* (Bhat kataiya) were found harbouring this pest. The bugs feed and breed on these weeds equally well as on brinjal.

In U. P. generally brinjal crop is removed by the end of April and new crop is sown in the beginning of July. During this period i.e. from May to June, when there is no regular crop of brinjal this insect migrates to the adjacent alternate host plants of *Kataiya* and *Bhat-kataiya*, as these weeds remain green throughout the summer. In the beginning of July when the brinjal seedlings become ready in nurseries, the insect migrates again to brinjal.

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Book Review

Agricultural Production Manual—1962, pages 182, price Rs. 2.50, published by Indian Council of Agricultural Research, NewDelhi with an Introduction by V. Shankar, Secretary, The Govt. of India (Department of Food and formerly Vice-President, I.C.A.R.).

The Manual is divided into eleven chapters, viz. Soil, Manures and Fertilizers; Minor Irrigation; Soil and Water Conservation; Seed Production of Improved Varieties; Improved Agricultural Practices Agricultural Implements and Machinery; Plants Protection; Commercial Crops; Horticulture; Land Use Planning; and Livestock Development. Each chapter deals with the scientific information on measures necessary for the planning, understanding and execution of the agricultural programmes of Indian agriculture. The approach used in the book is to give the necessary requirements and conditions necessary for the fulfilment of the agricultural programmes during the Third Five Year Plan.

The chapters have been written in simple English and presented in a systematic manner. The arrangements of various chapters is satisfactory, however, it is felt that the chapter on "Improved Agricultural Practices" should have been dealt with, much earlier. The appendices given are sure to prove useful to the farmers in scheduling the programmes of agricultural production.

On the whole, the Manual has been well written and well presented. It is hoped that it will prove useful to those engaged in farming, the extension workers and the students. The Manual is worth than the price of it.

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Review of the Report on National Grassland Field Day, Held in Tennessee, U.S.A. by Fred Berggren.

It may be somewhat surprising to some people to note the similar agricultural aspects that exist in both India and U.S.A. The following pose problems worthy of serious consideration in both countries; vast areas of land best suited to grassland agricultural,[1] a large livestock population which requires nutritious forage for high production of quality products; and an exploding population whose demand for these products is ever growing. The question of how to meet these demands in the most efficient manner with the resources available is very pressing.

Despite differences in the geography, climate, religious and political policies, etc. we, in India can learn much from those who have tackled problems similar to ours.

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[1]A farming system which emphasizes the importance of grasses and legumes in livestock and land management. From Hughes, H. D. *Forages* Ames, Iowa State, University Press, 2nd. Ed. 1962.

Leading professors and scientists, specializing in grassland agriculture in the U.S.A., have organized national conferences on the subject. They along with manufactures of agricultural implements, seed and fertilizer companies, farmers, extension men and teachers gather together for a Field Day where they share their finding and problems. Following is a brief report of the Second National Grassland Field Day and Conference held June 23-25, 1965 in Tennessee, U.S.A. which illustrates the increasing importance of forages to the United States and the World.

Over half of the United States' livestock feed comes from forages as a consequence more and more forages will be needed as the production of livestock and their products increase, said Dr. D. E. McCloud, U. S. Department of Agriculture scientist. He added that the world's population increase is difficult to comprehend but that it's supposed to reach 4 billion by 1975. Only 9 years from now. With the world's population growing at 2% per year and food production increasing at only, 1% per year the danger of widespread famine and unrest throughout the world is obvious.

The 28,000 people who attended the three-day field day and conference showed most interest in the alfalfas (Lucernes), corn, and orchardgrassses with much interest also expressed in the summer annuals—like the improved millets and sudangrasses and their hybrids.

In one talk Dr. Webster Pendergrass, Dean of Agriculture at the University of Tennessee, cited the importance of grasslands in licking the problem of increased food production. "Food is an important weapon in the struggle for existence...and grasslands provide the greatest undeveloped resource for increased food production, especially of livestock products, that is available in this country at the present time."

Once accurate statistics on the agricultural production resources of all of India are compiled we might very well find the same fact to hold true.

With no new frontiers of virgin land, American agriculture must look to increasing food and feed supplies from the acres we now have. First, hay and silage are the major raw materials for producing dairy products, beef cattle, mutton and wool. Second, the vast acreage of grasslands in the United States has a great total potential production, but needs to be converted to high production, Dean Pendergrass said.

"Experiments and practical farmer experience have shown that beef steers can be fattened to good and choice market grades on grass alone," he added. "And costs of hog production can be decreased considerably with good pasture."

"Top quality forage will continue to be the backbone of sound cow-calf beef programmes in the United States for years to come." So predicted Dr. Tony J. Chuha, head of the Animal Science Department at the University of Florida.

Much higher production is possible from just about all forages, Dr. H. D. Gross of North Carolina State University said. Dr. Gross, a forage crop ecologist, accused the plant breeders of not using their data to predict possible yields as they might. Bigger yields are possible through the use of more fertilizer, he explained.

"The average American farmer is using only about one per cent of the nitrogen, 40 per cent of the phosphate and about 20 per cent of the potash that he should be using in order to produce highest yields," said Dr. Gross.

However, the biggest job is to make plants more efficient. The greatest poundage of any present crop that can be grown is the corn plant at the rate of 1,500 pounds per acre per day during short periods of time. That is close to the desirable maximum of 1 ton per acre per day.

All forage breeders should examine all the growth and physical properties of all present plants, then come up with a planned programme to get more yield per acre.

Southern U. S. forage breeders have not been a bit lazy in rising to the need for new and better grasses and legumes for the South's booming livestock industry, according to Dr. Ward.

"There have been 73 or more new grasses and legumes created in the South since 1940," he explained.

Special recognition in the forms of both plaques and certificates was given to 40 pioneer workers at the Southern Pasture and Forage Crops Improvement Conferences. Many of these workers helped produce those 73 new forage varieties and hybrids. They formed their orgaization back in 1940, and 19 of them received 25-year awards. In addition, 21 certificates were given other honoured forage crop workers.

Different states and government agencies set up various educational exhibits in large tents. They were developed around themes varying from farm family living to farm animal nutrition.

The Third National Grassland Field Day and Conference for the United States will be held in 1967 in Nebraska, a plains or prairie state in the West edge of the "Corn Belt." A site has been chosen between Lincoln, the state capital, and Omaha, largest city in the state.

This report is just a small example of the total efforts being taken in the U.S.A. to make the most economic utilization of food production resources. In India, the need is extremely urgent for concentrated and sustained effort in food production and at the same time we must be aware of the immorality of producing 1 million more Indians per month without increasing our production of food and fiber, and our housing, medical and educational facilities at the same time.

L. G. Ulsaker
Agronomy Department
Agricultural Institute
Allahabad, U.P. (India)

Technical News

CAPITAL FOR DEVELOPMENT

Mr. P. A. Reid, the World Bank's representative with the Food and Agriculturre Organization, said, it had been estimated that $1,500 million in foreign exchange would need to be invested every year in agriculture in the developing countries if food targets were to be attained—BF730

POTASH FERTILIZERS IMPROVE THE KEEPING PROPERTIES OF BROAD BEANS

J. U. Hong investigated the influence of incremental applications of potash on the yield and quality of broad beans. With increasing dressings of a potash fertilizer (up to 200 kg $K_2°$ per hectare) the total content of hydrolysable carbohydrates (especially starch) rises whereas the proportion of lowmolecular sugars falls. From this, it can be concluded, that the activity of the decomposing enzymes (amlyase, saccharase, B-glucosidase) is reduced. This leads to an improvement of the keeping properties and reduces the loss by respiration during storage. In using these seeds for sowing, moreover, the enzymes develop which are required for good germination so that these plants soon surpass those of the potash deficiency plots in growth.—International Fertilizer Correspondence, Germany, 906. Vol. VI/4-April, 1965.

ACCUMULATION OF POTASSIUM IN THE SOIL WITH INTENSIVE FERTILIZATION

In areas of intensive vegetable crop production where large amounts of P and K fertilizers are applied annually both P and K will, according to the soil test, gradually accumulate in the soil in "available" forms. Once fertilization is stopped, however decline of the availability of the two fertilizer elements is different. A seven-year test shows the following results. Phosphorus accumulated in the soil in available forms during years of heavy P fertilization and the amount accumulated was directly related to the rate applied. Once fertilization stopped, the available P in the soil declined rapidly. However, the residual effect was very pronounced even after eight years of no P fertilization. Potassium fertilization was stopped, available soil K declined rapidly, and at the end of eight years, no residual effect remained. To ensure a proper balance between these two major fertilizer elements in vegetable growing soils, both P and K should be applied annually.—International Fertilizer Correspondence, Germay, 907. Vol. VI/4 April, 1965, under a 27 per cent light intenstiy. The data indicated that the effect of high light intensity on yield is primarily due to the promotion of vegetative growth and, consequently, of carbohydrate synthesis, whereas K promotes the conversion of metabolites into grain constituents. It would appear that K fertilizers are most effective when they are applied to crops grown in periods with less intense sunlight, i.e. during the rainy season.—International Fertilizer Correspondence, Germany, 909 Vol. VI/4. April 1965.

INFLUENCE OF FERTILIZERS ON THE PLANT'S CONSUMPTION OF WATER

In many climates in the case of crops which are not irrigated the amount of available water acquires the role of the factor that limits the growth of the plants.

The plants require a considerable amount of water in order to produce one kilogram of dry matter; this results from the transpiration of the leaves. The water requirement depends on the one hand on the kind of plant and on the other hand on the soil conditions. The amount of water consumed in order to produce one kilogram of dry matter in the case of wheat is 560 kg, maize 350 kg, sugar beet 380 kg and lucerne 880 kg. Maize is taken as an example of the way in which the nutrient supply of the soil and the fertilizer treatment influence the water requirement.

For the production of one kilogram of dry matter maize consumes the following quantities of water:

Soil fertility level	Unmanured	Manured
Poor soil	550 kg	350 kg
Medium soil	479 kg	341 kg
Fertile soil	392 kg	347 kg

It is seen from these figures that a fertilizer treatment of the soil reduces the consumption of water by the plants. This effect of saving water is especially marked on a poor soil. With a supply of 5,000 cubic meters per hectare (=500 mm or 20 inches) only nine tons of dry matter is produced without fertilizers, whereas with an adequate fertilizer treatment fourteen tons can be obtained.

Consequently the application of fertilizers is a means of saving water. This effect is particularly important for regions which suffer from summer drought. It is also important in regions which rank as being well supplied with rain, for it is not merely exceptionally that the amount of water is not sufficient to cover the plant's requirements.—International Fertilizer Correspondence, Germany, 911 Vol. VI/4. April, 1965.

SUGAR CANE NUTRITION IN AUSTRALIA

Manurial recommendations for Australian sugar cane soils are determined largely by the Bureau of Sugar Experiment Stations, the official research organization devoted to the technical advancement of the sugar industry. From the results of extensive research experience and continued field studies, coupled with a farm soil-analysis service available to all growers, the Bureau is able to issue sound recommendations on the nutritional requirements of the various sugar soil groups.

In a practical attempt to limit the possible number and variety of sugar fertilizer mixtures the Bureau arrived at three basic mixtures intended to meet the manurial needs of the majority of sugar cane soils.

The three initial Bureau recommendations were classified and divided into (a) planting and, (b) ratooning mixtures.

Mixture		N%	P_2O_5%	K_2O%
No. 1 Planting	Rich in P, low in K	1.0	17.0	7.5
No. 1 Ratooning		4.25	13.0	6.25
No. 2 Planting	Balanced P and K levels	1.25	12.75	15.0
No. 2 Ratooning		4.25	10.75	12.5
No. 3 Planting	low in P, rich in K	1.75	8.0	25.0
No. 3 Ratooning		4.5	6.5	25.0

Bureau soil studies of recent years have revealed a changing plant nutrient status of many sugar-cane soils. The change is most pronounced in sugar soils that have been under intense cultivation for many years. Of most significance has been the increase in phosphate levels and a noticeable potash depletion. Such changes are not altogether unexpected as sugar-cane is a gross feeder of nitrogen and potash; high quantities of these nutrients are lost in cut cane. It is estimated for example, that a forty-ton cane crop removes over 300 lb. of potash from the soil.

The long standing sugar fertilizer mixtures were replaced in 1962 by five revised Bureau recommendations. As from July 1st, 1962, the original Bureau recommendations were replaced by the followng mixtures:

Mixture	N%	P_2O_5%	K_2O%
Bureau 1	5.0	17.75	6.0
Bureau 2	5.0	11.75	17.5
Bureau 2A	2.5	15.0	17.5
Bureau 3	5.0	8.25	25.0
Bureau 4	5.0	3.75	35.0

Recommended application rates range from 300 kg/ha on fertile soils to 880 kg/ha on less fertile soils.

Research workers and growers alike recognize the problem of general potash depletion of Australian sugar soils. The accepted need for increased potash application is reflected in the higher potash percentages of the revised sugar fertilizer recommendations.—International Fertilizer Correspondence, Germany, 912. Vol/VI/4. April, 1965.

TECHNION (ISRAEL) PROFESSOR HEADS ASIAN REGION OF SOIL MECHANICS ENGINEERS*

Professor Joseph G. Zeitlen of the Technion, Israel Institute of Technology, was elected Vice-President for Asia, and thus head of the Asian Region of the International Society of

Consulate of Israel, 50 Pedder Road, Cumballa Hill Bombay—26.

Soil Mechanics and Foundation Engineers at its Sixth International Conference held recently in Montreal, Canada, and attended by more than 40-member nations.

This position will involve Professor Zeitlen, Head of Technion's Soil and Highway Engineering Laboratory, in preparation for the next regional conference in 1967 to take place in Israel.

Professor Zeitlen is also President of the Israel Society of Soil Mechanics and Foundation Engineering, a Fellow of the American Society of Civil Engineers, and President of the M.I.T. Club of Israel. He came to Israel in 1953 as a United Nations Expert in Soil Mechanics, advising both Technion and Tahal (Water Planning for Israel). He officially joined the Technion Faculty in 1958.

OBITUARY

We sorrowfully place on record the sad demise of Mr. Neol S.R.N. Dey, a member of the staff of the Agronomy Department, who expired on December 23, 1965 after a brief illness. Members of the Institute and specially the Agronomy Department staff send their heart-felt sympathy and pray that God may give peace and rest to the departed soul and give strength to the bereaved family mourning the loss.

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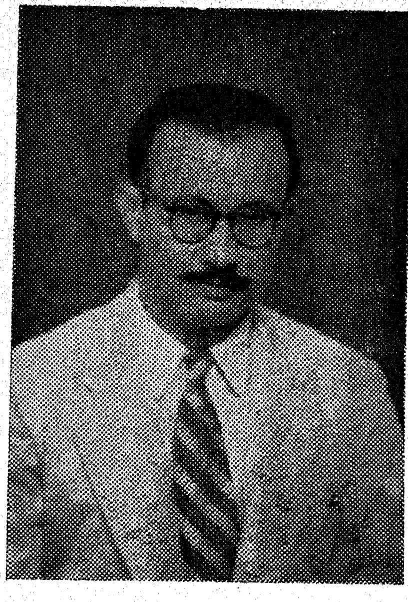


Mr. Noel S.R.N. Dey

Born : *16th February, 1920*

Died : *23rd December, 1965*

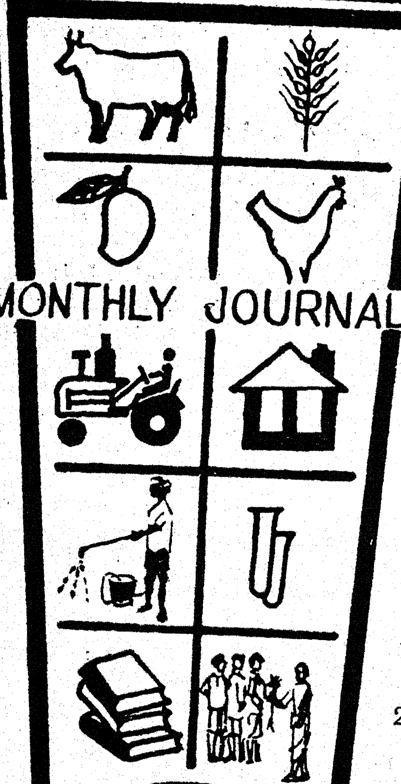
Mr. N. S. R. N. Dey was born in Daltonganj, Bihar. He attended the the Allahabad Agricultural Institute from 1936 to 1940 and graduated in 1940 specialising in Agronomy. From 1940 to 1943 he attended Indian Agricultural Research Institute, New Delhi from where he passed the Associateship Examination. Soon after he joined service with Bihar Government as a Senior Scientific Research Assistant in the I. C. A. R. Scheme. He resigned that post and joined the staff of the Agronomy Department of the Institute in 1946. He left the Institute in June 1948 to look after his own farming and got married on April 10, 1950 with Miss L. S. S. Bain, an alumnus of 1948 batch of Home Economics at the Institute.

Mr. Dey again joined the Institute staff in July, 1952 and was placed in Associate Professor's cadre in July 1957. He left for higher studies at the University of Illinois, U. S. A. for one year in September 1959 and returned to the Institute with an M. S. degree in Agronomy in September 1960 and was appointed Head of the Agronomy Department again from April 1961 to June 1962 which responsibility he executed so well. In 1964 Mr. Dey was appointed Officiating Head of the Horticulture Department, the responsibility he continued till the end.

During 15 years of his service to the Institute, Mr. Dey discharged his duties with great zeal, devotion and faithfully and to the best of his ability. He earned respect of his students not only as a good and devoted teacher but also as one who was genuinly interested in the problems and welfare of his students. By his frankness, enthusiams and friendliness, he endeared himself to all in the community. Mr. Dey was an active member of the Alumni Association.

He has left behind two lovely daughters, and a son, and his wife. God has separated Mr. Dey from us all but we all believe that in doing so God has some definite purpose which is beyond our imagination. We pay our tribute of love, respect and gratitude to him in memory. His passing away is a great loss to his colleagues and friends and to the Institute as a whole.

THE
ALLAHABAD FARMER



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ALLAHABAD, U.P.

Suggestion for Contributors to The Allahabad Farmer

Manuscripts dealing with all aspects of agriculture and rural life, eductional or research, are accepted for publication in *The Allahabad Farmer*. Manuscripts should ordinarily have more than purely local interest. Articles must be original material previously unpublished elsewhere. After review, each manuscript will be accepted for publication upon recommendation of the Managing Committee.

Manuscript. Two copies, one on bond paper, should be furnished for each manuscript. Double space everything—text, title, footnotes, literature cited, captions and tables (except in long tables). This is to provide space for clear marking for the printer. Number all pages consecutively. An additional copy of the manuscript should be retained by the author to ensure against loss.

Use as short a title as practical. Following the title give the author's name(s). It is desirable to divide the manuscript into sections with such headings as Methods and Materials, Results, Discussion, Summary, and Literature Cited. The order of items in the manuscript should be 1. Title and Author; 2. Text; 3. Summary; 4. Acknowledgment; 5. Literature Cited; 6. Tables; 7. Captions for figures; and 8. Figures.

Avoid underscoring headings, words or phrases unless they are to be printed in italics. Do not use solid capitals for titles. Measurements such as time, weight, and degrees should be in Arabic numerals regardless of the number of digits in the number. Where the figure is not one of measurement, figures below 10 should be spelled out except when one figure in a series has two digits, in which case all should be in Arabic. Scientific names of plants, chemicals, etc. or descriptions thereof should be given the first time used. Nomenclature, abbreviations, and definitions should follow standard references and those generally accepted for the purpose.

Footnotes. The title and address of the author(s) should be given as footnotes. Number footnotes to the text consecutively throughout the manuscript with superscript Arabic numerals. Designate footnotes to tables with superscript lower case letters.

Figures. Experimental data may be presented in graphic and tabular form, but the same data will not be presented in both forms. Photographs should be clear glossy prints and should be trimmed of unessential portions. Never use clips on photographs in any way. Graphs and drawings should be inked with heavy black lines to ensure clarity after reduction in size. Hand lettering should be large and clearly made preferably with a lettering guide; typing is not acceptable. Place the author's name on the back of each figure submitted. Type the legends for all figures on one sheet separate from the figures, in double space. Figures should be numbered consecutively in Arabic numerals.

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Literature Cited. Citations are numbered alphabetically by senior author; the number of the reference is used in the text. Citations should include names of all authors, year of publication, complete title, publication, volume number, and inclusive pages, in that order. When there are two or more authors, put initials after the name of the first and before the name of others.

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THE ALLAHABAD FARMER

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Physiology of Cutting, Budding and Grafting

MAN SINGH MANOHAR*

Introduction

Plant physiology is that branch of science which deals with the various functions including growth and reproduction of plants. Plants may be propagated by seeds or vegetatively; both resulting in multiplication of plants, have quite different effects. One of the attributes of seedlings is variation of individuals which may result in improvement or deterioration; on the contrary, vegetative propagation multiplies the individual. Vegetative propagation is the development of new individual plants (animals also) without the function of sex. The art of vegetative propagation has been practiced from the dawn of human history and many methods have been devised.

One of the most important factors which is leading to success in vegetative propagation of an increasing number of perennial plants is the better understanding of the implications of physiological processes of the plants so propagated. An attempt is, therefore, made to discuss some aspects of the physiology of the three most important methods of vegetative propagation, i.e., cutting, budding and grafting.

PHYSIOLOGY OF CUTTING

A cutting may be defined as any vegetative plant part which, when detached from the parent, is capable of regenerating the missing organs. So in plant propagation, any portion of a plant which is served from the parent plant for the purpose of propagation is called a "Cutting" and the process is termed as "Cuttage."

Cambium is the chief callus-producing tissue. Origin of callus may also occur in other living cells of the phloem, xylem, and phellogen. The callus tissue produced in these regions is quite homologous, composed mainly of cells which are more or less differentiated as parenchyma. Callus formation on stem or rootcuttings results from the activity of cells adjacent to those injured on the exposed surface at the time the cutting is made. These cells which lie immediately interior to the surface, enlarge greatly as a result of the increased food gradient. They then undergo a series of divisions to form the callus cushion. Although root production

*Central Arid Zone Research Institute, Jodhpur.

by cuttings is a separate and distinct process, it is closely allied to and generally follows callus cushion. Close inspection of callus tissue would reveal that it contains many isolated vascular elements. As the cutting matures, these vascular elements often become organized, thus affecting differentiation in adjacent callus cells; these in turn, form a root initial. Callus formation and subsequent differentiation of a particular tissue or organ is in part related to aeration and pH, which monitor the internal chemical mechanism governing their formation.

In stem cuttings of certain species (softwood, semi-hardwood, and hardwood) generally the adventitious roots are forced to come out on any part of the stem in suitable environment. When a part of shoot is separated from its mother plant, the immediate thing that it leaves behind, is the supply of water, and if it is not able to develop a mechanism for the absorption of water soon enough, it dies off.

Factors affecting root formation.

A. EXTERNAL FACTORS INFLUENCING ROOT FORMATION

1. Media

Media for initiation of roots must have the following qualities:—

(i) Loose and easily workable.
(ii) Retentive of moisture.
(iii) Well drained.
(iv) Free from disease-producing organisms like, fungi, bacteria, etc.
(v) Should be freely available at reasonable costs.

Taking above qualities into consideration the following media are the best suited for the purpose:—

(i) Clean sand, (ii) Loose sandyloam with good drainage, (iii) Acid peat, (iv) Vermiculite, (made up of very thin flat particles of mica which have been subjected to very high temperature), (v) Perlite, (vi) Coconut fibre, (vii) Saw dust, and (viii) Sphagnum moss, etc.

2. Temperature

Though high temperature is favourable for rooting of some species, it stimulates a high rate of transpiration particularly for herbaceous and semi-hardwood cuttings.

3. Humidity

Generally high degree of humidity should be maintained. Polythene covers have proved very suitable to maintain high humidity. Mist technique has also proved very helpful for the same.

4. Light

Strong sun light is harmful particularly for leafy cuttings and in such cases provision for partial shade has proved quite helpful.

5. Chemical treatments

Used to induce root formation in species that are difficult to root; in early days it included (i) Potassium permanganate solution, (ii) Dilute solutions of vinegar and of cane sugar.

More recently plant regulators or hormones derived from plant tissue or produced synthetically, have been used to stimulate plant growth, especially root formation in cuttings. The

most widely use of these are—(i) Indole-3-acetic acid, (ii) Indole-3-butyric acid, (iii) Naphthalene acetic acid and in addition ethylene, acetylene, propylene, and carbon monoxide gasses stimulate development of roots of certain cuttings.

6. Mechanical treatments

(i) *Retention of leaves:* In some plants rooting response is proportionate to the leaf area, e.g., in the case of citrus cuttings, the removal of terminal half of each leaf retards root formation and reduces the total amount of roots produced.

(ii) *Position of basal cut:* Some plants root best, if the basal cut is so made that a node is left at the base of the cutting, a few root best if the internode occurs at the base.

A wound made at the base of cutting often causes better root formation. This is done by slitting the bark on one or two sides. This treatment increases the area from which roots may be expected to form, and roots often develop along the margins of the wound. Ringing and knotching are also important as they affect C/N ratio of plants which directly affect root formation.

B. INTERNAL OR STRUCTURAL FACTORS

These include conditions within the cutting, which may influence its ability to form roots and develop into a plant. They are as follows:—

1. *Stored food:* It has been shown that the available carbohydrates and nitrogen markedly affect the rooting by keeping alive the activity of cutting and stimulating cell division

2. *Age and maturity of tissue*: If the cutting is soft and immature it becomes weakened more readily from transpiration and more susceptible to decay. Zimmerman and Hitchcock (1949) showed that there is a relation between the age of plant tissue and its natural capacity to form adventitious roots.

3. *Callusing*: Recently it has been accepted that it does not play an important part in root formation. Some cases have been observed where roots originated in the callus tissue, but that is not very common. Callus formation may be of benefit in sealing the end of the cutting and preventing decay.

PHYSIOLOGY OF GRAFTING

Grafting is an operation in which two cut surfaces of the same or different plants are so placed as to unite and grow together. The plant or the part of the plant on which grafting is done is called stock. The part which is inserted in the stock or grafted into it, is called the "scion."

The characters of both scion and stock have been mutually combined by grafting to adopt the adversities faced by stock and scion under different situations. Both of them benefit from each other. This mutual relationship is known as symbiosis and each is a simbiont of the other.

Callus formation by stock and scion in grafting results from the activity of either the cambium or the living cells of phloem and xylem. After the graft has been made and placed in a suitable environment for callusing, there is a gradual intermingling of the calluses produced by the component parts. As callusing continues, vascular cambium is formed immediately adjacent to that in both stock and scion. The new ormed bridging cambium which by this time continues to function in a manner similar to that of the stock and scion, that is, it cuts off

new xylem elements to the interior and new phloem elements to the exterior. Sometimes there is an intermingling of tissues of stock and scion and this may result in what is known as a chimera.

Factors affecting success in grafting

The success or failure is governed by the following three conditions, in addition to the external and internal factors discussed under cutting except media:

(i) The compatibility of each plant.
(ii) The closeness of fit and
(iii) Cambial contact.

Compatibility

The physiological and anatomical disorders and diseases are the main causes of incompatibility. The incompatibility between grafted plants has been found of the following types:

(*a*) Combinations of species, varieties, or clones which never form a grafting union.
(*b*) Combinations in which a number of unions formed are relatively small.
(*c*) Combinations in which a union is formed, growth occurs, but the plant eventually dies.
(*d*) Combinations which produce deficiency symptoms or nutritional disorders.
(*e*) Combinations which result in stunted or dwarfed trees.
(*f*) Combinations producing differentiation in growth at or in close proximity to the graft union.
(*g*) Combinations causing degeneration of tissue systems, abnormal distribution of stored food reserves, and premature defoliation.

Causes of incompatibility

(i) Nutritional or normal relationship.

(ii) Distortion of vascular tissues between stock and scion (result into check of water, flow of minerals, and elaborated food).

(iii) Deposition of wood parenchyama and bark layer between the graft interfaces.

(iv) Formation of whorls or loops in the vascular or conducting tissue at a point of union may also contribute to structural weakness by restricting the transportation system.

(v) A breakdown of medullary systems with the resulting formation of woundgums at or in close proximity to the point of union.

(vi) The production of auxins or other synthesized products in the stock and scion union may also cause incompatibility which has been reported in citrus and apples.

(vii) Time of grafting and selection of proper scion.

Closeness of fit and cambial contact also affect successful union. In addition to these Molotovskii and Poruckii (1951) showed that leaf extract from scion leaves applied to the roots stocks of fruit trees (apple, pear, plum) resulted in a quicker and slightly better graft union than a similar treatment with growth substances.

PHYSIOLOGY OF BUDDING

Budding is a detached method of grafting which consists in inserting a single natural bud (with little or no wood) with a piece of bark attached to it taken from the plant which is des-

cribed to be propagated, underneath the bark of the stock plant in such a way that the nascent cambium tissues of the stock and the scion (the bud) are brought into contact with each other (always growing in normal position), and binding the part operated upon.

Shield budding is the most common method of budding for Pome fruits (apple, plum), stone fruits (Peach, pear, apricot and cherries, etc.), citrus species and Mango. Many plants which produce woundgum resulting from injury to xylem or wood of the stem can be grafted only by budding successfully. Stone fruits such as peach and cherry are excellent examples of the woundgum-producing trees which are seldom grafted by the methods which necessitate the injury of the xylem issues.

CONCLUSION

By vegetative propagation we are able to raise plants of the same genetice constitution as the parent, thus enabling horticulturists to multiply even heterogygous strains, bearing desirable characters, evolved by the breeders. The science of grafting has made possible the acclimatization of desired varieties, dwarfing of fruit trees, production of uniform and high quality crops; and economic marketing by introducing rootstocks which produce the desired effects. Furthermore, it has been possible to grow disease susceptible but otherwise desirable varieties by grafting them on hardy and immune rootstocks. The desirable characters, e.g., thornlessness, early bearing etc. have been successfully introduced by this method of propagation.

The vegetative propogation, which has so many advantages, is not easy to follow and requires a thorough understanding of the skill and the fundamentals of its physiology before one can claim to be a successful propagator.

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Effect of Spartin and Foliar Spray of Micro-nutrients, Singly and in Combination on Growth and Yield of *Zea mays* (L)

M. L. VERMA*

The importance of the micro-nutrients in the correction of nutritional deficiencies is more apparent than their ability to increase yield of crop plants, although effects in improving crop yield have, occasionally, been credited to them (Lal, K. M., and Rao, M. S. S. 1954). There is considerable experimental evidence that boron is an important factor involved in organic synthesis (Shive, 1941). Bordeaux mixture has been found many times to increase yield of potato, even when the control of disease was not a contributing factor (Lutman, 1911, Cook 1923 and Lutz 1936). As in other crops nutrition of micro-nutrients is closely associated with the formation of auxin, ascorbic acid content, carbohydrate and protein metabolism. Hence the present account deals with the effect of micro-nutrients and spartin on the growth and yield of corn.

MATERIALS AND METHODS

The experiment was conducted in a typical gangetic alluvium soil. There were 9 treatments, comprising (i) control, (ii) N.P.K., (iii) N.P.K.+Mn, (iv) N.P.K.+Cu, (v) N.P.K.+Zn,.(vi) N.P.K.+B, (vii) N.P.K.+Mo, (viii) N.P.K.+combination, (ix) N.P.K.+Spartin Treatments were replicated twice in a randomized design with a plot size 32′ x 18′. Analysis of a composite soil sample was as below:

TABLE 1. *Machanical and Chemical Analysis.*

Mechanical analyses		*Chemical analyses*	
sand	60.1%	Total N	0.0322%
silt	18.7%	Total P20 5	0.024%
clay	13.7%	Total K	0.712%
		pH	8.2
		Total Mn	100 PPM
		Total Cu	62.5 PPM
		Available B	0.65PPM(in saturation extract).
		Available Mo	0.2 PPM

Application of Nutrients—Basal Nutrition—after the preparation of seed bed, a basal dressing of N, P & K (30:30-:30) in the form of ammonium sulphate, superphosphate and potassium chloride was done at 130, 188 and 50 lbs. respectively.

Micro-nutrients—Spartin**was mixed in the soil at the time of sowing at 150 lbs. per

**Analyses of spartin is as below (Dr. Ch. Krishnamoortey).

Nutrients	*Percentage*	ppm
Ca	19.0	
Mg	5.25	
Fe	1.648	16,480
Cu	0.356	3,560
Zn	0.155	1,550
B	0.023	230

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acre. Micro-nutrients were sprayed in two lots at an interval of 15 days (1st spraying after 40 days and second after 55 days of sowing) as given in Table 2.

TABLE 2. *Common name, chemical formulae, and rate of spray used.*

Form in which applied Common name/Chemical formulae		Approximate Nutrient %	@ per acre	Total volume of spray in gall.	Conc. of spray in %
Manganese sulphate ..	$MnSO_4 . H_2O$	23, Mn	10 lbs	100	0.5
Zinc Sulphate..	$ZnSo_4 . 7H_2O$	32, Zn	10 lbs	100	0.5
Copper Sulphate.	$CuSo_4 . 5H_2O$	32, Cu	10 lbs	100	0.5
Borax ..	$Na_2B_4O_7 . 10H_2O$	10.8, B	5 lbs	100	0.25
Sod. Molybd. ..	.. .. ..	38, Mo	5 lbs	100	0.025
Combination of all		——	35.5 lbs	100	1.25

Studies:—Height of the plants was measured in cms from soil surface to ligule of younger leaf and grain yield was calculated in Kg /acre. Other studies were done in four cobs and averaged.

EXPERIMENTAL FINDINGS

Growth—Average growth in the form of height of the plants at an interval of 25 days has been summarized in Table 3.

TABLE 3. *Height of the plants at the 25 days of interval.*

Treatments	at 25 days	at 50 days	at 75 days
Control	23	92	100
NPK	35	134	109
NPK+Mn	28	118	105
NPK+Zn	23	112	116
NPK+Cu	29	125	94
NPK+B	24	106	99
NPK+Mo	28	123	113
NPK+combination ..	22	113	110
NPK+spartin	26	102	124

A perusal of the data indicated in Table 3 initially shows a slower rate of growth. After the first spray of the micro-nutrients, the rate was accelerated. Maximum height of plants was recorded in NPK treatment. But the growth rate of plants was more in NPK combination treatment, Followed by NPK Zn, NPK B, NPK Mn, NPK Cu, NPK Mo, NPK

spartin, NPK and control, being the minimum (413.6,386.9, 341-7, 339.3, 324.1, 321, 4, 300, 292.3 and 282.8% respectively).

As the age stepped up from 50-75 days a conspicuous change in the height of the plants was noticed. The height of the plants was found to be increase in NPK spartin, control and NPK Zn treatments (18.08, 8.5 and 3.4% respectively). This increment was in 75 days over 50 days. While other treatments showed a decrease in the height as indicated below:

Treatments	*Percentage decrease over 50 days*
NPK+Cu	32.9
NPK	22.4
NPK+Mn	11.8
NPK+Mo	8.8
NPK+B	7.07
NPK+spartin	2.7

TABLE 4. *Fresh and dry weight—Perc ntag: dry matter.*

Treatments	at 25 days	at 50 days	at 75 days
Control	10.7	16.5	32.7
NPK	10.5	16.6	34.0
NPK+Mn	9.5	16.8	36.9
NPK+Zn	11.1	15.2	31.2
NPK+Cu	9.7	13.7	29.2
NPK+B	10.2	16.7	28.2
NPK+Mo	10.6	1818	34.5
NPK+combination	10.9	15.5	34.8
NPK+spartin	10.3	16.9	32.4

Table 4 shows an increasing trend of dry matter with age. Maximum dry matter was recorded in NPK Mn treatment at the 75 days of sampling and minimum in NPK Cu treatment. If dry production is taken as the index of net growth then it is logical to conclude that the manganese is very important factor in the growth of plants.

Yield and other Studies—Yield being a composite character, various components of yield such as test weight, length of cob, number of rows per cob and number of seed per row were also studied. Table 5 summarizes average values for yield and its various components.

A survey of Table 5 indicates that in all the treatments yield is increased. Highest grain yield was obtained in NPK Mn treated plots, followed by NPK Zn, NPK B, NPK combination treatment was best among the rest of the treatments.

When test weight was taken into consideration, NPK Zn stand at the top, second to it was NPK spartin, followed by NPK B and other treatments. Length of the cobs was fouud to be highest in NPK Mn followed by NPK comb. Highest number of rows was found in

TABLE 5. *Showing grain yield, test wt., length of cobs etc.*

Treatments	Grain yield Kg/acre	Test wt. in gms. (wt. of 1000 Seeds)	Length of cobs in cms	No. of rows per cob	No. of grain/row
Control	64.0	64	8	13	16
NPK	91.5	85	8	10	14
NPK+Mn ..	226.0	80	10	13	14
NPK+Zn ..	140.0	100	10	11	17
NPK+Cu ..	95.5	80	8	10	15
NPK+B	108.5	91	8	10	13
NPK+Mo ..	87.5	80	8	13	16
NPK+combination ..	102.0	87	9	12	17
NPK+spartin ..	97.0	98	6	11	12

NPK Mn, NPK Mo and control followed by NPK comb. and other treatments. Number of grains per row was more in NPK Zn and NPK combination treatments.

DISCUSSION

A perusal of the data previously presented aptly demonstrates that foliar spray of the micro-nutrients, singly and in combination maintained an outstanding responses over control, NPK and NPK spartin. Observations regarding the responses of foliar spray of micro-nutrients of plant's height showed that maximum increase in height of plants was recorded in NPK comb. and minimum in control. The best responses in case of NPK comb. are fairly logical as plant might have received all the required micro elements. The responses of Zinc are due to its easier and increased absorption. As zinc is helpful in increasing several enzymic reactions (esterases, nucleases, peptidases etc.) affecting the transformation of the carbohydrates, it might help in increasing auxin content and maintaining adequate ascorbic acid (Hoagland, 1944, Reed 1946, Tsui 1948 and Ferres and Brown). The root extension and development by the application of zinc (Shrivastava, R. P. 1964) might lead to increased absorption of other nutrients. Next best treatment was NPK B, as the boron plays role in organic synthesis, maturation and differentiation of the cells, translocation of the carbohydrates and in the formation of pectin (Shive, 1941, Gausch and Dugger 1954, Stok 1948).

Molybdenum lead to the enhanced protein synthesis, since protein is responsible for new cell formation and therefore nitrogen is an essential nutrient for the plant growth as it is a constituent of all proteins and hence of protoplasm. It is also considered as a constituent of enzyme nitrate reducrase. The responses of copper may be due to the more root formation, extension and development (Shrivastava, R. P. 1964), consequently plants may take up more nutrient from the soil. Absorption of copper might have activated various enzymes like

ascorbic acid oxidase, laccase and tyrosinase (Starky, R. L. 1955). Probably copper enzymes also participate in the photosynthetic system (Arnon, 1948). Manganese is essential for the carbohydrate and protein metabolism of the plants.

At 75 days growth was found to decrease in all treatments (micro elements sprayed treatment), except in NPK Zn and NPK spartin. Science micro-nutrients application may utilize more of plant's energy in seed setting and development, also at maturity plant cells shrink, which consequently results in the decreased plant height.

Grain yield was maximum in NPK Mn treatment. Since manganese is essential for the carbohydrate metabolism. This might have resulted in more starch formation of the grain. Higher number of rows per cob also observed in this treatment, resulting in higher yield. Zinc application enhances phosphorus and calcium uptake (Rogers and Wu 1948). Phosphorus as orthophosphates plays a fundamental role in so many enzymic reactions that depend upon phosphorylation. Phosphorus with calcium might be responsible for the increased test weight (100 gms), length of cob (10 cms) and number of grain per row (17) over all treatments; which may be the potent reason for the appreciable yield.

Next best treatment was NPK B in grain production, possibly because it is an essential factor for the seed setting (Berger K. C. 1957). Other treatments were not very much superior over NPK and control.

Increased yield was also observed by manganese and zinc application (Jain, S. V. and Mehta, K. M. 1963, Datta and Gurubasava 1955). There was 48% increase of grain yield by micro-nutrient application in Bihar (Ray Chaudhary, S. P.). Responses of micro-nutrients were also observed by Sadaphal and Das (1956).

SUMMARY

From the foregoing account, it may be concluded that micro-nutrients play an increasingly vital role in the development of plants, grain setting and development. The main points of conclusion are:

(i) NPK Zn and NPK combination proved best in enhancing height of the plants.

(ii) NPK Mn treatment indicate highest yield over all treatments.

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Relationships of Sedimentation Value and Grain Protein and Other Flour Quality Characteristics of Six Wheat Varieties.*

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In India some work has been done at the Indian Agricultural Research Institute, New Delhi, to compare the different varieties of wheat for *chapati* making qualities (3). However, milling and baking qualities of wheat by modern methods have not been thoroughly investigated. Also, limited data are available on the extent to which the protein content and sedimentation value may be differentially affected by wheat varieties.

This investigation was conducted to study (i) the milling and baking qualities of wheat in relation to variety, and, (ii) the relationships of protein content with sedimentation value of farinograph absorption with dough development time, resistance time, and valorimeter values; and, of resistance time with valorimeter readings.

MATERIALS AND METHODS

Six improved varieties: NP 710, NP 823, NP 824, NP 825, NP 880, and NP 810 were sown at the Agricultural Farm of J. V. College, Baraut (district Meerut) U.P., on October 27, 1964. The experimental design was a simple randomized blocks with four replications of 6-row plots, 15 plants in each row. Rows were spaced 23 cm apart.

Grain samples were analyzed for total nitrogen by the Kjeldahl procedure (2) and per cent protein was calculated by multiplying per cent N by 5.7. Gluten was determined by a modification of the procedure outlined by American Association of Cereal Chemists (1) and was expressed as dry gluten per cent by weight. Sedimentation values were determined according to the Zeleny method (1). Brabender Farinograph was made use to determine the quality of flour. All data were subjected to statistical analysis by the method of Shedecor (5). Simple correlation coefficients were used to evaluate the relationship between protein content and sedimentation value, and between various quality characteristics of flour.

RESULTS AND DISCUSSION

The analysis of variance for protein, sedimentation value, gluten, and flour yield showed highly significant differences among varieties (Table 1). For grain protein, NP 823, NP 710, and NP 825, had almost the same protein percentage. These varieties were better than the rest three. Varieties NP 824 and NP 880 fell in the same category and both of them were individually better than NP 810. This suggests that varieties differ in their inherent ability to utilize available soil nitrogen in the production and deposition of proteins. This is in conformity with the findings of Stickler *et al.* (6) who noted variations in protein percentage of four wheat varieties. With one exception, gluten percentage responded in the same way as grain protein.

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TABLE 1. *Mean square values*

	Protein %	Sedimentation value	Gluten %	Flour yield %
Varieties	2.99**	80.87**	3.11**	5.73**

**Significant at the 1% level of probability.

Mean sedimentation values were 25, 21, 20, 20, 14 and 13 for NP 824, NP 823, NP 880, NP 825, NP 710, and NP 810 respectively. The varieties therefore could be classified in three distinct groups. The differences are associated with inherited characteristics which cause one protein to swell more than another when placed in an acid environment. The distinctive behaviour of varieties for grain protein and sedimentation value has also been recorded by Stickler *et al.* (6). They have held that variety significantly affected protein content and sedimentation value of hard red winter wheat.

Data no milling quality presented in Table 2 suggest that flour yield differed significantly for varieties. The highest recovery of flour was obtained from NP 823. This yield was higher than that of other varieties. Varieties NP 880, NP 825, and NP 824 were identical. These three varieties yielded more flour than did NP 710. Differences between flour yields of NP 810 and NP 824 could not be detected. Similarly, NP 824 and NP 710 responded in a similar way. These data lead to a conclusion that flour yielding ability is an inherited characteristic of each variety. The differences in flour yields of varieties tested in this study are in conformity with the observations of McNeal *et al.* (4).

TABLE 2. *Grain protein, sedimentation value, gluten content, and flour yield of six varieties of wheat.*

Variety	Protein %	Sedimentation value	Gluten %	Flour yield %
NP 710	10.5	14.3	9.7	73.5
NP 823	10.8	21.0	9.4	77.0
NP 824	9.6	25.0	8.0	74.4
NP 825	10.5	20.0	9.6	75.4
NP 880	9.5	20.3	8.6	75.5
NP 810	8.5	13.0	7.6	74.8
SEm±	0.1	0.5	0.2	0.3
LSD 5%	0.4	1.6	0.6	1.0

The mean square values for farinographic studies showed highly significant difference among varieties (Table 3). Differences in farinograph absorption were profound inasmuch as all the varieties could be arranged in descending order of NP 825, NP 824, NP 880, NP 710, NP 823, and NP 810 (Table 4). Such variations among varieties for absorption have also been obtained by McNeal *et al.* (4).

TABLE 3. *Mean square values*

	Farinograph absorption %	Dough Development time(min.)	Stability time (min.)	Farinograph Resistance (min.)	Valorimeter
Varieties	55.04**	1.08**	18.28**	23.45**	919.47**

**Significant at the 1% level of probability.

TABLE 4. *Farinograph absorption, dough development time, stability time, Farinograph resistance time, and valorimeter readings of six varieties of wheat.*

Variety	Farinograph absorption %	Dough Development time(min.)	Stability time (min.)	Farinograph Resistance (min.)	Valorimeter Reading
NP 710	69.2	1.4	1.0	2.5	30.0
NP 823	68.6	2.5	1.1	3.6	40.0
NP 824	73.0	1.6	2.5	4.2	43.0
NP 825	74.5	2.2	6.5	8.8	69.0
NP 880	71.4	1.1	1.5	2.6	30.0
NP 810	64.0	1.4	1.0	2.5	30.0
SEm±	0.2	0.1	0.1	0.2	0.8
LSD%	0.6	0.4	0.3	0.5	2.4

For dough development time, varieties NP 823 and NP 825 did not differ significantly. The flour of these varieties took 2.5 and 2.2 minutes respectively in reaching dough stage. But these two had more dough development time as compared to the remaining four, which, excepting one, fell in the same time category i.e. 1.1 to 1.4 minutes. This suggests the suitability of these varieties for bakery purposes where dough development time is required for high resistance time. (Resistance time is the summation of dough development and stability times). Thus it may be concluded that stability time remaining the same, the resistance time will increase with every increase in the dough development time. Hence the dough consistency.

The highest stability time was displayed by the flour of NP 825 followed in order by that of NP 824 and NP 880. The flour of these varieties showed higher stability time than those of the rest three, which had almost equal stability time.

With one exception, farinograph resistance and valorimeter readings responded in the same way as stability time. The valorimeter response to varieties as evident in the present experiment agrees with the findings of McNeal *et al.* (4). These workers in their experiment noted a clear-cut difference among the five varieties of wheat for valorimeter values.

Another objective of this study has been to investigate the relationship between grain protein percentage and sedimentation value, and between various quality characteristics of flour. Correlation coefficient between protein content and sedimentation value did not come

out significant (Table 5). This is contrary to the general observations that if nitrogen reflects true glutein protein, a high correlation between protein content and the sedimentation value would be expected (6). However, in certain cases, a nonsignificant relationship between sedimentation value and protein content observed by Stickler *et al.* led them to conclude that other factors were affecting the swelling power of the proteins subjected to an acid environment. So, a non-significant correlation between protein content and sedimentation value observed in his study is just normal.

TABLE 5. *Correlation coefficients between protein content and sedimentation value, and between other quality characteristics of flour.*

Characters Correlated	"*r*" *value*
Protein content and sedimentation value	+0.18
Farinograph absorption and dough development	+0.57*
Farinograph absorption and resistance time	+0.46
Farinograph absorption and valorimeter	+0.31
Resistance time and valorimeter	+0.95**

*,**Significant at 5 and 1% levels of probability, respectively.

A significant positive relationship between farinograph absorption and dough developing time was noticed. This showed that dough developing time (the mixing time required by the flour from the moment doughing starts to the time it reaches optimal dough development) coupled with the volume of the kneaded flour increased with increase in farinograph absorption. The resistance time and valorimeter value remained unassociated with farinograph absorption. On the other hand, a highly significant relationship between resistance time and valorimeter value suggested that higher resistance time tended to give higher valorimeter readings —a symbol for better quality.

SUMMARY AND CONCLUSIONS

Variety significantly affected protein and gluten contents, sedimentation value, flour yield, farinograph absorption, dough developing time, stability time, farinograph resistance and valorimeter readings. The order of superiority of one variety over others was randomly distributed. However, in almost all farinographic studies NP 825 exhibited better performance and was closely followed by NP 824.

A non-significant correlation between protein content and sedimentation value suggested that other factors were influencing the swelling power of proteins subjected to an acid environment. However, significant relationships between farinograph absorption and dough developing time, and between farinograph resistance and valorimeter reading were observed. Other correlations used in this study could not reach the level of significance.

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Value of Vegetable Growing

I. S. Singh*

The Latin term Olericulture is used for vegetable growing or vegetable gardening, which is usually considered as one of the major branches of Horticulture. A vegetable is usually an edible herbaceous plant or part thereof that is commonly used for culinary purposes. Some vegetables are edible only after being cooked, others are eaten either cooked or raw, while still others such as watermelon, and muskmelon are used only in the fresh state. The value of vegetables and their growing may be considered from many aspects.

1. Dietetic or Food Value

Vegetables are acknowledged as an essential article of daily diet of every human being, in order just to keep fit and continue to work as a normal member of the community. Hence a knowledge of dietetic value of vegetables is necessary for everyone.

(*a*) *As a source of vitamins*:—Vitamins are organic substances essential for life but the human body is unable to elaborate them. They act as catalysts in many vital processes and are very necessary for health and the well-being. The role of different vitamins in the body and their sources in the vegetables are given in the table.

Vitamins	*Function in the body*	*Good sources*
A. ..	(i) Necessary for growth of children .. (ii) Maintains health and vigour throughout the life. (iii) Prevent night blindness, ophthalmia and helps guard against infection.	Carrot, spinach, sweet potato, peas, dry and green, pumpkin, watermelon, okra, potato, tomato, cabbage, lettuce.
B. .. (*a*) B_1 or thiamin.	(i) Necessary for growth .. .. (ii) Prevents berri-berri disease .. (iii) Absence leads to neuritis (nervous troubles) and irritability.	Peas (Dry and green), potato, cauliflower, bhindi, cucumber, radish, cabbage, spinach, tomato.
(*b*) B_2 or Ribo flavin.	In its sbsence .. .. .. (i) Growth is checked .. .. (ii) Development of sores at the corner of mouth and tongue.	Spinach, peas, cabbage, cauliflower, cucumber, beetroot, carrot, onion, tomato.
"C" Ascorbic	(i) Essential for growth of children.. (ii) Helps in healing of wounds and fractures. (iii) Promotes health gum .. .. (iv) Prevents scurvy disease	Spinach, peas, "greens" cabbage, beans, sweet potato, tomato, potato, cauliflower, Muskmelon, radish, pepper, egg-plant, turnip, knolkhol.
"D" ..	(i) Prevents rickets .. .. (ii) Necessary for strong healthy teeth .. (iii) Important for bone formation and softening of bones.	Green vegetables are particularly rich in this vitamin.
"E" ..	(i) Essential for reproduction ..	Peas, onion, and green vegetables.
"F" ..	(i) Prevents pellagra disease .. .. (ii) Necessary for growth of young.	Lettuce and other green vegetables.

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(*b*) *Vegetabl:: as a sou ce of proteinr*:—Such vegetables are dried peas and beans are rich in proteins that are essential for building the body tissues.

(*c*) *Vegetable as a source of minerals*:—The minerals or inorganic elements play various roles in the human system as components of skeleton, structures as cellular constituents and as regulators of the body neutrality.

MINERALS:		SOURCES
Calcium (Ca)	..	Spinach, dry peas, cucumber, cabbage, cauliflower, pumkin, turnip, okra, onion, carrot.
Phosphorus (P)	..	Cauliflower, spinach, okra, green peas, tomato, radish, turnip, peas dry, cabbage.
Potassium (K)	..	Spinach, tomato, muskmelon, cucumber, radish, peas dry, water-melon, cauliflower.
Sulpher (S)	..	Cabbage, cauliflower, onion, radish, turnip, spinach, tomato.
Iron (Fe)	..	Spinach, tomato, muskmelon, radish, cucumber, cabbage, carrot, lettuce, beetroot, onion, peas green.
Iodine ..	..	Spinach, radish, okra, turnip, watermelon, carrot, tomato.
Copper (Cu)	..	Cucumber, spinach, cauliflower, radish, potato, tomato, peas.

(*d*) *Vegetables as a source of energy*:—While most vegetable make their contribution to the diet more as source of minerals and vitamins rather than as a source of caloric energy and protein in which they are deficient, a few of them such as potatoes, sweet potatoes, peas and dried seeds of beans are significant as energy foods or source of calories.

(*e*) *Vegetables as a source of roughages*:—The term roughages denote the indigestible carbohydrates mostly cellulose and hemicellulose. Vegetables are the main source of roughages for proper working of digestive machinery and prevention of constipation. In the course of digestion, meat and other proteins there is increase in body acidity and this is neutralized by the alkaline reaction of the body. Most vegetables particularly leafy ones like cabbage, spinach, letuce and various Indian "sags" and most of the root crops contain a high percentage of roughages and therefore, act as main sources of roughages.

2. Economic Value

Importance of vegetables should be more recognized not only because of their good taste and supply both basic and necessary nutrients, also because they furnish maximum quantity of food for per unit area planted within a brief period or minimum period and grow quickly. They have proved highly valuable in situations of marginal food supply and of actual famine. During World War I, Germany made intensive use of turnips, because they grow quickly and the yield of bulk carbohydrate and other nutritive materials is greater in relation to the area planted. Thus on the individual level, home gardens make a saving in the food budget by having tiny plots. Market gardeners realize substantial income from intensive culture of limited lands. At the national level, people with high density of population and those at war value the quite heavy yields of root vegetables and potatoes as bulk work against hunger.

3. Industrial Value:

Potatoes and sweet potatoes are few of the most efficient starch-producing plants. In the recent years they have assumed great importance for industrial purposes some of the products that are produced as starch, dextrine glucose, gasoline, alcohol, flour dried and shredded potatoes. The lowest grade potatoes can be very economically utilized for cattlefeed on the farm. On the other hand, canning and preservation of vegetables also help to enhance the development of subsidiary industries like those of tin, glass, etc.

4. Medicinal Value:

It has been fairly well established that a diet lacking in such substances as vitamins and minerals result in a number of ailments such as scurvy, berri-berri, rickets and poor body development. Leafy vegetables root crops and pods are a rich source of minerals and vitamins· Bhindi (Okra) is said to stimulate gastric juices and therefore, should be omitted from the menu of persons suffering from gastric or peptic ulcer. Amaranthus leaves are used against drug poisoning and also to alleviate constipation. Cucumber is used as a diuretic. Bitter gourd is used as curative against Malaria. Radishes are used for treatment of liver troubles, gall stones, gall bladder troubles, etc. Ginger is recommended for digestive trouble. Turmeric is considered a blood purifier and is said to further prevent rickets. Use of suran (elephant yam) is recommended as curative against excessible bile. A new cabbage juice concentrate is being used to heal pectic ulcers.

5. Recreational Value:

The operations such as sowing, planting, hoeing, thinning, fertilizer application and irrigation are included in gardening which are healthful giving outdoor exercises aside from being profitable recreation. Then there are the joys and thrills that stimulate the gardener mentally as well. It is one project in which all the members of the family may unite for the common good.

6. Utilization of Farm Resources:

There is better utilization of labour capital and resources on the farm when vegetable growing is undertaken. We have idleness and unemployment of labour in all types of farming but vegetable farming precludes these. It provides opportunity for work to both skilled and unskilled labour.

On the whole vegetable growing should continue to assume importance as profitable field of agriculture. The industry can be considerably encouraged and supported by better marketing facilities adopting more economical methods of production through increased knowledge of soil technology, use of improved varieties and better insect and disease control methods and the elimination of unnecessary operations and use of labour saving machinery. The present population of India is 44 crores and most of them are vegetarian. It, therefore, requires about 27 crores and 50 lakhs lb. of vegetables at the rate of 10 oz. per head per day. It is thus imperative that research, teaching and extension activities concerning vegetables should be given more emphasis in view of the increasing needs of the country for this valuable type of food and energy.

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Bionomics of Amsacta Moorei Butler (Lepidoptera: Arctiidae)

R. L. Gupta, N. D. Pandey, S. Ram and T. R. Sukhani*

The red hairy caterpillar *Amsacta Moorei* Butler is a polyphagous insect feeding upon a large variety of plants. During the course of present studies at Kanpur, the larvae were found feeding on Sunn-hemp (*Crotelaria juncae*) *Bajra* (*Pennisetum typhoideum*), *Urd* (*Phaseolus mungo*), Cowpea (*Vigna catjung*), *Moog* (*Phasolus aureas*), Ground nut (*Arachis hypogaea*) Sweet potato (*Ipomoea batata*) *Kodon* (*Pospalum scrobiculatun*) and Lucerne (*Midicago sativa*).

The maximum damage is done during July-September. The first and second stage larvae feed gregariously on the parenchymatous tissues first and then devour the entire green vegetable matter leaving only the lower epidermis. The later stages disperse all over the plants feeding voraciously.

The copulation takes place during night after 1-2 days of emergence of adult moths and lasts for 75 to 115 minutes. Eggs are generally laid on the lower surface of the leaves in masses. A single female laid 146-615 eggs in 2-3 days time.

The eggs are spherical or globular in shape and slightly depressed at both the ends. Freshly eggs are shining yellowish-white, later on become orange deep yellow. Incubation period was 3-5 days.

There are six larval instars and each stage takes 3-4, 3-6, 4-7, 5-7 and 5-8 days respectively. The full grown larva measures 27-30 mm in length with a grey mid-dorsal line. The larva is velvety black in colour, covered with tuft of hairs. Total larval period ranged 23-40 days.

Pupation takes place inside the soil (3″-6″ deep) or fallen leaves. Before pupation larva spins a rough cocoon of its own body hairs. Freshly formed pupa is pale yellow which later on terns light brown in colour. The pupal stage occupied 6-12 days.

The adult moth is of medium sized with black sports on the forewings. It has crimson abodomen with back bands dorsally and row of black spots laterally. The fore pair of wings have light red line along the anterior margin. The moth measures 16-20 mm × 38-50 mm. Males have pectinate antennae and pointed slender abdomen, while the females possess thread like antennae and broad abdomen. Moths are nocturnal in habit. During day time they remain hidden under clods, leaves, etc.

Amsacta moorei hibernates in pupal stage under soil in winter season. It resumes its activity from July when sufficient rain has fallen. A rush of moths from hibernating pupae occurs during the first fortnight of July. The adult females after emergence copulate and start oviposition on young seedlings of Sunn-hemp crop. When the Sunn-hemp crop matures the pest migrates to other plants. The maximum activity was noticed during July to September. The pest remains in scanty number up to December. One to two generations have been observed in a year from July to November.

The Amsacta moorei, the red hairy caterpillar is widely distributed in plains of India and is a pest of wide range of crops. In India the earliest report of *Amsacta moorei*, was made by Barlow

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in the year 1903. Srivastava and Goel (1962) have published some notes on its biology and control measure of this species. Some information is also available in the allied species of Amsacta in India and abroad. Maki (1916) reported *Amsacta lactinea* Cram. as injurious pest on mulberry plants in Formosa; Gater (1925) observed *A. lactinea*. Cram, on chillies plants in Malaya and Ayyar (1940) found *A. albistriga*, Walker as a serious pest of many garden crops in South India.

METHODS AND MATERIAL

The larvae of all stages were collected from Sunn-hemp (*Crotalaria juncae*), Maize (*Zea mays*) and Juar (*Sorghum vulgare*) from Government Agricultural College, Campus and other cultivated fields. The rearing was made in glass chimneys, glass jars and cages of different sizes. The fresh and tender Sunn-hemp leaves were supplied daily for feeding. The moths emerged from pupae were kept in wiregauge cages with small potted seedlings of Sunn-hemp. The moths were fed upon 5 per cent glucose solution soaked in cotton wool.

To estimate the percentage of damage 200 plants were picked up from each Sunn-hemp plot and average damage was calculated in terms of percentage.

FOOD PLANTS

Amsacta moorei is a polyphagous insect. It is recorded from large variety of food plants mostly belonging to the family Leguminacae and Graminae. Lefroy (1906) in Madras reported it on Groundnut (*Arachis hypogaea*); Fletcher (1917) in Mysore on Juar (*Sorghum vulgare*), Groundnut (*Arachis hypogaea*) and Castor (*Ricinus communis*); Jhaveri (1917) in Bombay on Til (*Sesamum indicum*) and Maize (*Zea mays*) and he again noted it in Gujrat on cotton plants (*Gossypium spp.*), Bajra (*Pennisetum typhoideum*), Moth (*Phaseolus acontifolius*), and lablab (*Dolichos lablab*); Lal (1917) in Punjab on Urd (*Phaseolus mungo*) and Cow pea (*Vigna catjung*); Pruthi (1938) in Delhi on Sunn-hemp (*Crotalaria juncae*), Cow pea (*Vigna catjung*), Soyabean (*Glycine hispida*), Maize (*Zea mays*), Til (*Sesamum indicum*) and Guar (*Cyamopsis psoraloides*); Isaac (1944) again in Delhi on Cow pea (*Vigna catjung*), Juar (*Sorghum culgare*); Bindra (1956) in M. P. on Maize (*Zea mays*) and Moong (*Phaseolus aureus*) Butani (1961) reported *Amsacta* spp. feeding on Millets, Paddy, Til, Jute, Sweet potato, Sunflower and various weeds.

In the present investigation at Kanpur a thorough search was made for the different host plants and the pest was noted to feed on Sunn-hemp (*Crotalaria juncae*), Bajra (*Pennisetum thypoideum*), Urd (*Phaseolus mungo*), Cowpea (*vigna catjung*), Moong (*Phaseolus radiatus aureus*), Groundnut (*Arachis hypogaea*), Sweet potato (*Ipomoae batates*). In addition the authors have also recorded kodon (*Paspalum scrobiculatum*) and lucerne (*Medicago sativa*) as new host plants.

NATURE AND EXTENT OF DAMAGE

Attack of *Amsacta moorei* starts from the seedling stage when the crop hardly attains a height of about 6 inches. The damage is caused by the larvae which feed on the yound and tender leaves of plants. Therefore, the young seedlings suffer much.

The damage starts from the edge to midrib. The first and second stage larvae feed gregariously on the parenchymatous tissue first and then devour the entire green vegetable matter leaving only the lower epidermis. The leaves are thus turned into papery membrane. The first and second stage larvae do not cause much damage but the larvae of later stages

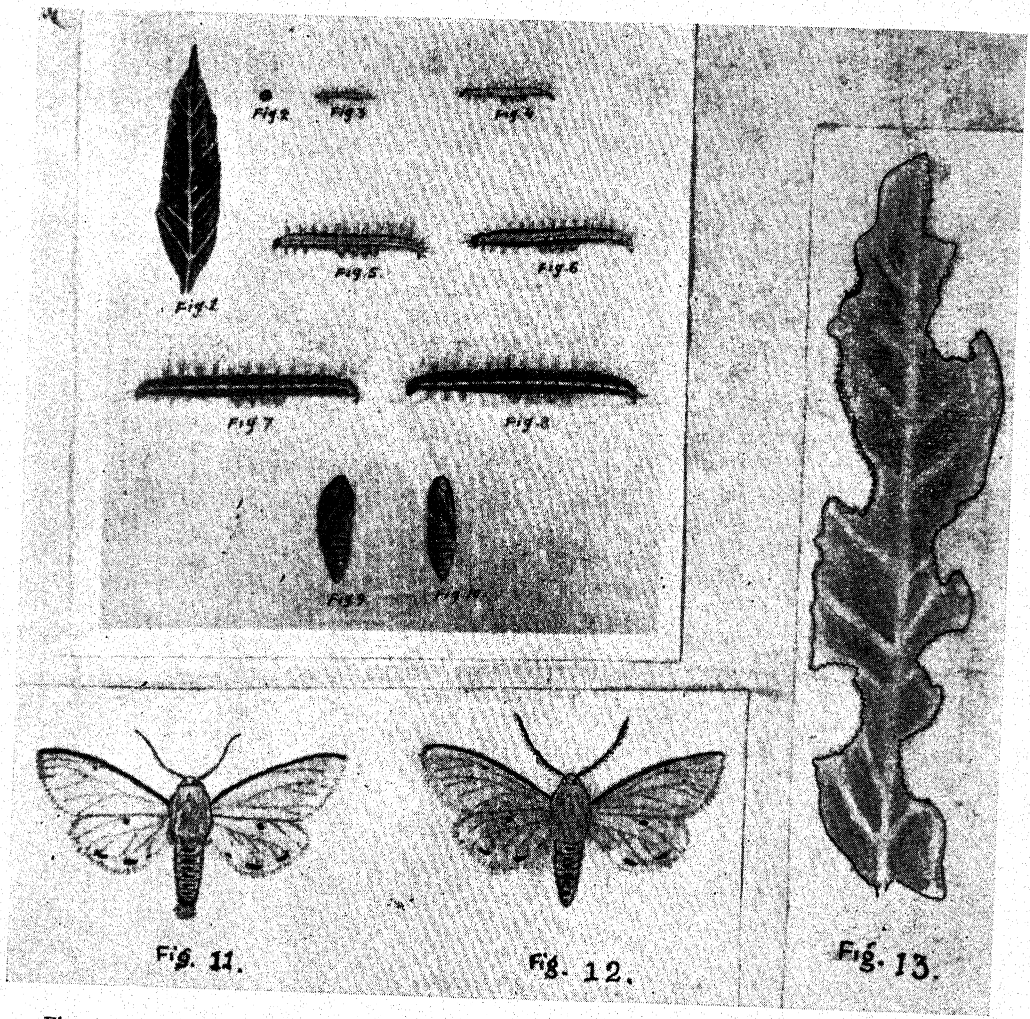

Fig. 1 & 2 Eggs, Fig. 3 First instar larva, Fig. 4 Second instar larva, Fig. 5 Third instar larva, Fig. 6 Fourth instar larva, Fig. 7 Fifth instar larva, Fig. 8 Sixth instar larva, Fig. 9 & 10 Pupa, Fig. 11 Female moth, Fig. 12 Male moth, Fig. 13 Damaged leaf.

disperse all over the plants, feeding voraciously and cause a heavy amount of loss. The larvae make semicircular, straight or irregular cut on the leaf lamina. During servere attack wholesale devastation of crop has been observed.

The damage was at its peak during July, August and mid September. In September the plants grow older and leaves become hard and consequently the damage decreases. The damage was 10 per cent in July, 35.5 per cent in August and September and on an average it being 18.74 per cent.

Life History

Amsacta moorei have been recorded in two distinct phases of life cycle at Kanpur, first inactive or hibernation period lasting from 15th December to June and second active period of life cycle which remains from July to November.

Copulation:

Copulation takes place after 1-2 days of emergence of adult moths. Copulation always takes at night or in early hours of morning. The duration of copulation varies from 75 minutes to 115 minutes. Copulation takes place only once in its life time.

TABLE 1. *Showing Precopulation, Preoviposition, oviposition and incubation periods*

Date of emergence	Date of copulation	Pre-copulation period (in days)	Date of oviposition	Pre-oviposition period (in days)	Last date of egg laying	Egg laying period (in days)	Date of hatching	Incubation period (in days)
25-8-'60	27-8-'60	2	29-8-'60	2	30-8-'60	2	2-9-'60	4
30-8-'60	31-8-'60	1	2-9-'60	2	4-9-'60	3	6-9-'60	4
6-9-'60	7-9-'60	1	8-9-'60	1	9-9-'60	2	11-9-'60	3
15-9-'60	17-9-'60	2	20-9-'60	3	22-9-'60	3	24-9-'60	4
21-9-'60	23-9-'60	2	25-9-'60	2	27-9-'60	2	30-9-'60	5
25-9-'60	27-9-'60	2	28-9-'60	1	29-9-'60	2	1-10-'60	4

Oviposition:

The female moths start oviposition after 1-3 days of copulation. The egg laying always starts at night. In the field conditions the eggs are generally found on the lower surface of leaves in clusters. Under captivity the eggs are laid either on the lower surface of leaf, wall of the chimney and even on wiregauge cages. The tender and juicy leaves are generally preferred for egg laying, the females are prolific. The total number of eggs laid by a single female varied from 146-615 in 2-3 days time.

Eggs (*Fig. 1-2*)

The eggs of *Amsacta moorei* are spherical or globular in shape slightly depressed at both the ends. It measures 0.5 × 0.45 mm. The freshly laid eggs are shining yellowish-white and after about a day they become orange to deep yellow, and on hatching they turn grey brown. The incubation period of the egg varied from 3-5 days depending on the season and weather conditions.

Hatching:

The tiny larva hatches out from the egg by biting a hole in the chorion at the anterior top portion of the egg. The empty egg shell looks papery white in colour. The larva after emergence leaves the egg shell without disturbing its position. Hatching usually occurs in the night or in early hours of morning.

Larval Stages:

First Instar larva (Fig. 3): It measures about 1.5 mm to 2 mm in length. The newly emerged larva is more or less cylindrical in shape gradually tapering posteriorly. The head is very small as compared to its body. It is slightly flattened dorsoventrally. The body is brownish yellow in colour with faint pale line dorsally. The body is covered with black and white hairs. The thorax bears 3 pairs of blackish legs. Abdominal legs are present on the 3rd, 4th, 5th and 6th abdominal segments and one pair on the last abdominal segment. This stage occupies 3-6 days.

Second Instar larva (Fig. 4): The body and head is increased in size. It measures about 6 mm in length. Body is reddish-brown in colour. Black and white hairs are arranged in lines and become more prominent. Thoracic legs are pale in colour. This stage takes 3-6 days.

Third Instar larva (Fig. 5): In this stage the body is characteristically blackish-brown with while dorsal line. The red spots on the white dorsal line are visible. The bunches of black and white hair are arranged in series of lines all over the body. The larva measures about 13 mm in length and also occupies 3-6 days.

Fourth Instar Larva (Fig. 6): The larva is dark blackish-brown in colour and measures about 21 mm. in length. The red spots are clearly visible. The head is well developed and marked with inverted "Y" shaped suture. The bunches of hair are more prominent throughout the body length. This stage occupies 4-7 days.

Fifth Instar larva (Fig. 7): The larva measures about 24 mm. in length. The larva is black in colour with white dorsal line. Now the dark brown spots are present on the dorsal white line of the body in spite of red one. The head is dark brown in colour. The mouth parts are well developed. Six ocelli and a pair of jointed antemae are present. A double line of hairs on the dorsal side and single line on each lateral side of the body are quite distinguisbable. This stage takes 5-7 days.

Sixth Instar larva (Fig. 8): In this instar the larva attains its maximum development. It is velvety black in colour and is covered with tuft of hair. Six ocelli are more prominent. A pair of three jointed antennae are present on the anterior edge of the epicranium at the bases of mandibles. The full grown larva measures 27-30 mm. in length. The white dorsal line turns into grey colour. Nine pairs of spiracles are visible; one pair on the prothoracic segment and eight pairs on the first eight abdominal segments. This stage occupies 5-8 days and the total larval period varied from 23-40 days.

Pupa *(Fig. 9-10)*: The larva before pupation stops feeding and remains inactive. It contracts in size and shrivels its body and faecal material is excreted out. The larva searches a suitable place for pupation. It spins a rough cocoon of its own hair around its body and rests inside it for about 1-2 days.

The newly formed pupa is pale yellow but later on it becomes orange to light brown in colour. After 2-3 days it changes into dark brown in colour. The length of the pupa varied from 10-15 mm.

According to Fletcher (1914) the full grown larva falls down on the ground and pupates under the soil. At Kanpur the full fed larvae pupate in the soil at about 8″ deep or among the plant debris or in rolled leaves (only when the soil is very hard). Under captivity pupation took place on the sides of petridishes containing soil.

Woodhouse (1913) reported that in the case of *Amsacta lactinea* it takes about a fortnight for moth to come out from the pupa. The pupal period of *Amsacta spp* as recorded by Butani (1961) varies from 10-11 days. In our observations at Kanpur this period varied from 6-12 days.

TABLE 2. *Showing the duration of larval and pupal periods in different months*

Months	Larval stages in days						Total	Pupal period in days	Total larval and pupal period
	I	II	III	IV	V	VI			
July ..	3	3	3	4	5	5	23	..	..
August ..	3	3	4	5	5	6	26	6	32
September ..	4	5	5	5	5	6	30	6	36
October ..	5	6	5	6	6	7	35	8	43
November ..	6	6	6	7	7	8	40	12	52

Adult (*Fig. 11-12*): The adult moth is of medium size with black spots on the wings. It has crimson abdomen with black bands dorsally and a row of black spots laterally. The fore pair of wings have light red line along the anterior margin. The moth measures 16-20 mm in length and 38-50 mm in wing expense. The male and female adult moths can easily be recognized by examining the antennae (Pectinate in males and thread like in females) and last abdominal segment (Pointed and slender in males and broad in females).

The moths are nocturnal in habit and both sexes are strongly attracted to light during night. During day time they are found hidden under fallen leaves, twigs and even under the clods in the field. If it is disturbed it soon searches out a fresh shelter for hiding. In the laboratory it rests on the walls of the cages with overlapped wings. It prefers glucose solution more than the sugar syrup as artificial food. The average life of both sexes is about seven days. The females live longer (eight days) than the males (six days).

Sex Ratio: The study of the sexes reveals that there is no appreciable difference in the population of sexes. The ratio of male and female was 1:0.95. In August females outnumbered the males but it was reversed in September and October.

Seasonal History: *Amsacta moorei*, hibernates in the pupal stage under the soil in winter season. The active life cycle of *Amsacta moorei* starts from the month of July when sufficient rain has fallen. A rush of moths from the hibernating pupae occurs during the first fortnight of July. The adult females after emergence copulate and start oviposition on the young seedlings of Sunn-hemp crop. When the Sunn-hemp crop is mature the pest migrates to other alternate host plants.

The emergence of moths depends upon the amount of rainfall and temperature. Maximum activity was noticed in the month of July and August. The activity of this pest continues till middle of December.

Number of generations:

Butani (1961) recorded only one generation of *Amsacta* spp. in a year, while in the present studies one to two generations have been found from July to November.

SUMMARY

The *Amsacta moorei* remains active from July to November. This is a polyphagous and serious pest, feeding on a large number of plants belonging to the family luguminaceae and graminae. Various authors have recorded its food plants as Groundnut, Castor, *Til*, Lablab, Cowpea, Soyabean and *Moong*, etc. At Kanpur this pest has also been observed feeding voraciously on *Kodon* and Lucern plants.

Adults copulate after one to two days of emergence. 146-615 eggs are laid by a single female in 2-3 days time. There are six larval instar and total larval period varies 23-40 days. Pupation takes place in the soil or among the fallen leaves in a rough cocoon. The adult moths are of medium size with black spots on the wings and a light red line along the anterior margin of the fore wings. There are 1-2 generations in a year.

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A Comparative Study of Mouldboard Ploughs of Tillage Operation

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Introduction

Tillage refers to the different mechanical manipulations of the soil that are used to provide the necessary soil conditions favourable to the growth of crop. Several scientists such as Wimer and Harland (1925), Blake and Aldrich (1956), Bowers and Bateman (1960), Johnson and Taylor (1960), Swamy Rao (1960), Khan (1953) and Kodama (1959) have shown that proper tillage operation is essential for plant growth. It is the most expensive operation in the chain of various items concerned in crop production. About thirty per cent of the total power consumption in agriculture is expended in tillage. Over half of this is used in the basic operations of ploughing and listing. Tillage operation can be divided into two classes, namely, primary tillage and secondary tillage. Plough is basically a primary tillage tool which is used to break and loosen the soil in the preparation of seed bad. It is the oldest agricultural implement though its exact date of coming into existence is not known. However in Eastern countries it is used as early as 2500 B.C. In Ramayana its name is mentioned as Nagali and in Mahabharat as Hala which terms are still used in many parts of India. During past few years there is a revolution all over India to replace Desi wooden plough by a suitable mouldb a·d plough. To cope with this dynamic revolution testing of ploughs was conducted at the Agricultural Research Institute, Kanke (Ranchi), Bihar. The object of the experiment was to select suitable mould board plough for Chotanagpur region of the State of Bihar by conducting trials of the existing improved ploughs collected from different places. The data presented here are the results of three years' experiment. During course of trials from year to year those found unsuitable during the very first year were eliminated from subsequent trials.

Review of Work

No extensive literature is available to review the entire work done in India. Charley was the first man who did some work in Madras State on foreign ploughs but the data and method followed are not available. Cluston (1906) studied foreign and Indian agricultural implements and concluded that the manufacturers of foreign ploughs have not considered Indian agriculturist point of view. Henderson (1909) designed a wooden plough and tested in irrigated tracts of Sind. Godbole (1913) designed a new plough and compared it with existing Deccan Plough by finding the average resistance per unit area of cross-section of the furrow width with the help of spring balance dynamometer. Mayadas and Hansraj (1931) did some test to evaluate the efficiency of some improved ploughs by finding the average resistance per unit cross-sectional area of the furrow slice and horse power required to work them. Cliff (1927) studied the relative merits of all the implements useful for the farm. Rao (1941) made tests for the comparative studies of some Indian ploughs with dynamometer at Delhi. He collected 40

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different ploughs from different parts of the country and compared them on the basis of their constructional features, drawbar pull, depth and width of ploughing, soil resistance and horse power requirement. He concluded that those ploughs which have cross-section of the wedge of plough with vertex at the top $\triangle$ give lesser unit draft as unit draft as compared to those having ∇ vertex at the bottom.

Experimental Design:

Site of experiment: Agricultural Research Institute, Kanke, Ranchi, Bihar.

Design: Randomised Blocks.

Treatments: Eight.

1. A.E.R.—8 plough
2. A.E.R.—6 plough
3. A.I. Co. Plough
4. Bihar senior plough
5. Bihar junior plough
6. Shabash plough
7. U. P. No. 1 plough
8. Wahwah plough

Amongst these A.E.R.-8 and Bihar senior ploughs are 8 inches plough and others are 6 inches plough.

Replications—4

Subplot size—70′ × 30′

Crop—Maize

Field Conditions:

(i) Type of soil—sandyloam

(ii) Condition of soil—Dry and full of weeds.

(iii) Preceding treatment—Fallow

(iv) Previous crop—Wheat.

Procedure:

The comparative study was made by using the implements under actual field conditions to evaluate their performance in doing the job for which they have been designed by replicated trials. Each plot was ploughed by respective plough and observations such as draft, depth of ploughing, width of ploughing, output and speed were taken. Draft was measured by tying spring dynamometer between plough and yoke and determining the horizontal component of pull by multiplying cosine of angle of hitch. Depth of ploughing was measured vertically along the furrow wall and width of ploughing was measured horizontally across the furrow and along the furrow sole. Output and speed of ploughing were determined by measuring time required to plough each plot and time taken to travel known length of furrow by means of a stop watch. The effects of varying capacities of men and bullocks were minimised by replicating the operators and bullocks along with implements. Fifty observations were taken for each replication and the reliability of average figures are checked by statistical analysis. Horsepower required for ploughing was calculated by using the following formula.

$$\text{H. P.} = \frac{\text{Draft (lbs)} \times \text{Speed (mph)}}{375}$$

RESULTS AND DISCUSSIONS

No significant difference in yield was found. Yield is not considered to be an important factor in evaluating the performance of ploughs because the yield is itself function of several variables though the agronomists are of opinion that the performance of any agricultural implement is reflected in the yield. Power requirement was higher in the case of Bihar senior plough and A.E.R.-8 plough than other ploughs, the reason being higher draft. There was not any markable difference in power requirement for other ploughs. During field operations hitching trouble was observed in the case of Bihar senior, Bihar junior and A.I. Co. plough as there is no other arrangement for vertical hitching to set the plough excepting notches in the beam. Output was maximum in the case of A.I. Co. and minimum in the case of A.E.R.-6 whereas the depth of ploughing was maximum in the case of Bihar senior plough and minimum in the case of A.E.R.-6. Thus from the test results shown in Table 1 it is very difficult to conclude the best performance as no single plough is superior to others in all respects. Hence in order to evaluate the performance of these implements a performance index can be introduced. The performance of mouldboard plough is function of width of cut, depth of cut, speed, area covered per unit time and inversely proportional to unit draft. All these factors can be combined into one factor which may be used to study the comparative performance of plough.

TABLE 1. *Test results of Mouldboard Ploughs*

S. No.	Treatments	Draft (lbs)	Soil-resistance lbs/sq. in	Width of furrow (inches)	Depth of furrow (inches)	Speed (mph)	Output per day (ac)se	Horse Power required H.P.	Yields mds/acres
1	A.E.R.-8	174.00	5.73	8.00	3.80	1.19	0.64	0.552	98.00
2	A.E.R.-6	110.00	5.10	6.00	3.60	1.40	0.50	0.411	70.00
3	A.I. Co.	142.50	6.56	5.50	3.95	1.21	0.71	0.46	96.00
4	Bihar Senior	172.10	4.18	7.50	5.50	1.14	0.69	0.523	97.00
5	Bihar Junior	145.20	4.95	6.00	4.90	1.07	0.67	0.415	88.20
6	Shabash	146.10	5.05	6.30	4.60	1.14	0.62	0.440	91.50
7	U.P. No. 1	141.00	5.50	5.70	4.50	1.16	0.706	0.435	84.0
8	Wahwah	134.50	4.56	5.90	5.00	1.00	0.65	0.358	70.00

$$P = \frac{W \times d \times s \times A}{D}$$

where P = Performance Index

W = Width of cut in inches

d = Depth of cut in inches

s = Speed of ploughing in mph.

A = Area covered per unit time

D = Draft in lbs.

This is not an absolute formula and equation is not homogeneous. Based on the above formula the comparative performance of implements is given in Table 2.

TABLE 2. *Performance Index for different Mouldboard Ploughs*

Sl. No.	Treatments	Performance Index
1	A.E.R.-8 plough	4.05
2	A.E.R.-6 plough	2.96
3	A.I. Co. plough	2.85
4	Bihar senior plough	7.75
5	Bihar junior plough	4.25
6	Sabash plough	4.04
7	U.P. No. 1 plough	3.83
8	Wahwah plough	4.20

From Table 2 it is obvious that Bihar senior plough has maximum performance index whereas performance for A.E.R.-8, Bihar junior plough, Shabash plough, Wahwah plough and U.P. No. 1 is almost same. Performance Index is very low in the case of A.E.R.-6 and A. I. Co.

Conclusion:

Test results of different mould board ploughs indicate that amongst 8″ plough, performance of Bihar senior plough is the best whereas among 6 inches plough Bihar junior plough gives the best performance.

ACKNOWLEDGMENT

The author is deeply indebted to Dr. M. P. Sinha, Agricultural Engineer (Research) Bihar, for suggestions and guidance.

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Technical News

HUNGER SIGNS OF MAIZE

Maize is a very important cereal crop. Besides being consumed by human beings, it is also an important ingredient for livestock and poultry feeds.

The problem of maize shortage however could be solved by the farmers themselves through the adoption of good practices or methods of maize culture from seed selection to proper harvesting and storage. These should be done in order to get maximum yield per unit area and with the least possible cost of production leaving a bigger margin of profit for the growers.

Plants require 14 elements that are considered necessary for normal plant development. These 14 elements are required in different quantities by different species or varieties of plants grown under different conditions for normal plant growth. A given soil is said to be well-balanced with regard to plant feeding when the above mentioned plant nutrients are present in the right proportions for a given crop.

When one of these is lacking or deficient, plants exhibit what agriculturists term as hunger signs. These signs or symptoms as others call them serve as the language by which plants tell that they lack the required nourishment for normal development. Due to the many complicated factors surrounding a plant's environement, correct interpretation of nutrient deficiencies in the field is difficult. Insect attack, diseases, mechanical injuries, water logging and unfavourable weather conditions cause symptoms that are very similar to that due to plant food deficiency. Hence, the value of laboratory tests or analyses to determine more accurately the causes of given symptoms. Advanced countries usually use the chemical tissue test to determine nitrogen, phosphorus and potassium deficiencies in the field.

A well-fed maize plant has a stalk diameter that is large with heavy nodes. Abundant available nitrogen, phosphorus and potassium will give this condition. The leaves must be wide, shiny with a waxy luster with uniform dark green colour. The brace roots must be big and lusty and when the maize is ripening, the whole plant including the outside husk of the ear should remain green.

The maize plant like animals shows signs of hunger when its lacks the necessary plant food for proper growth and reproduction. Signs of malnutrition are usually observed as a result of a shortage of some of the most important plant nutrients.

The visual deficiency symptoms of the three major elements are described in the following:

Nitrogen: Young maize exhibits stunting, leaves become greenish-yellow to orange-yellow with the tips of the leaves gradually drying. In older maize, yellowing starts with the older leaves and follows the midribs from the tips. Later the tips begin to dry and drying progresses until the whole leaf is completely dried. This is referred to as "firing." The drying of leaves due to lack of moisture is easily differentiated from nitrogen deficiency since wilting begins from the top portion of the plant downwards, the tissues wither and dry out not necessarily becoming yellow.

When the ear ripens with a white outside husk, this means the lack of nitrogen also.The heaviest maize ear and the deepest kernels come from miaze where ripening process turns only the inside husks white while the outside remains green. The higher the nitrogen supply at the time of ripening, the higher will be the protein content of the maize.

Phosphorus: Maize plant given enough nitrogen and potassium supply but still shows retarded growth rate and slow to mature, means the lack of phosphorus. Maize not receiving enough of this element usually has dark green colour, spindling with stems and leaves becoming purplish in colour.

Potassium: Lack of potassium in maize will turn young leaves into yellowish-green to yellow in colour. Sometimes yellow streaking of the leaves is observed. Edges and tips of leaves become dry and scorched. The margin and leaf scorching is an outstanding potassium deficiency symptom. Ears are usually unfilled at the tips, not plumb with poorly matured and starchy kernels. International Fertilizer Correspondent, Germany, 904. Vol. VI/4—April, 1965.

MAKING THE MOST OF YOUR SOIL

The soil is the farmer's basic asset. Upon its productive capacity he must depend for his living.

It is not within the farmer's power to change the type of soil on his farm; that is, he cannot change a sandy soil to a silt loam. He can, however, improve his particular soil by proper management. Proper soil management includes:—

1. Selection of a suitable rotation;
2. Maintenance of the proper degree of acidity or alkalinity depending upon the crops which are being grown;
3. Adequate preparation and cultivation;
4. Control of erosion;
5. The addition of organic matter either in the form of stable manure or cover crops;
6. Last but not least, the proper feeding of the crops with the right kinds and amounts of fertilizer.

The primary reason for adopting a sound rotation, from a soil fertility viewpoint, is to increase the organic matter in the soil and thereby improve its physical condition and moisture-holding capacity. There are many secondary results; including a better utilization of planted food reserves, an increase in beneficial bacterial, the avoidant of certain insect pests and diseases and a conservation of the native fertility in the soil through the reduction of leaching and erosion.—International Fertilizer Correspondence, Germany, 905. Vol.VI/4 April, 1965.

AMAZON CUCUMBERS

Dutch plant breeding has booked excellent results in the last few years with the improvement and selection of cucumbers. Some of the most remarkable successes are the bitterfree and gummosis and leaf spot disease resistant varieties.

Research people are working very hard of late, to remove another extremely disagreeable nuisance viz. the problem of the commercially useless bull-necked cucumber. In order to achieve this, selection farms are trying to breed plants that bear female flowers only.

In this they have, for the greater part, been successful.

There are already two Dutch selection farms (Pennevis—Delft and De Ruiter—Bleiswijk) marketing a number of hybrid varieties which produce female flowers only. They are called "manless" varieties. ("Amazon" cucumbers).

On many horticultural holdings market gardeners have, apart from using amazons for experimental purposes, also planted these varieties on a large scale for commercial ends. It is estimated that, for the latter purpose, a glass area covering approx. 350,000 sq. metres has been planted.

What new points have come to the fore in the cultivation of these new amazon varieties?

As compared with the existing varieties, shorter fruits, particularly with fruits on the stem.

The amazon plants usually show a somewhat weaker growth.

Moderate and careful pruning is to be recommended.

The taste of the amazon is judged favourable. On many sides the taste is considered even better than that of the usual varieties. The colour is often lighter.

Without undue risks, the planting of the new amazon variety may be recommended for late hothouse, outdoor and autumn cucumbers.

The selection farms too are busy, and are hard at work improving their manless material. It is to be expected that other plant-breeding farms will also busy themselves with this subject so that it will not be surprising if more and better varieties turn up shortly.

GOAT HUSBANDRY IN THE NETHERLANDS

The number of goats in the Netherlands has decreased greatly since 1945 and at present amounts to approx. 30,000 head. Yet each province has several goat-breeding societies that have joined into unions, which in their turn are co-ordinated in the "Dutch Goat Breeding Association."

Goats are mainly kept for their milk, which is consumed by the holder's family itself.

At the last annual meeting reference was made to the fact that there are more uses for the milk, such as deliveries to children's hospitals, and for yoghurt and cheese making, as is done on a large scale in France and Norway.

The 1964 average milk production amounted to 888 kg with 3.87% butterfat in 305 days. In illustration the highest milk production on record is mentioned viz. 1,900 kg with 6.33% butterfat, produced by the four-year-old Willie in 302 days, a performance that certainly demands respect.

Other outstanding productions are given below:

Age		*kg. mile*	*% butterfat*	*days*
1 year	.. ..	1,523	4.05	320
2 years	.. ..	1,452	3.94	297
3 years	.. ..	1,435	3.59	297
4 years	.. ..	1,450	3.29	339

In five provinces a.i. is successfully applied.

Export of goats is strady. In 1963 goats went to Greece, Jordan, Bolivia and Chile, and more than 100 animals have already been exported to Greece in 1965.—Agricultural Newsletter from The Netherlands, November 1965.

FILLERS

Concentration

The Co-operative Dairy Selling Associations are negotiating for the establishment of one Central Dairy Selling Association.

If they succeed a formidable organization will have been formed, with an annual supply of the following quantities:—

49,000	tons of butter
104,000	tons of cheese
53,000	tons of milk and whey powder.

A total of 250 dairy factories will join the Central Association.

Some more news on goats

Thirty-four milk-recorded goats, including 13 one-year-old animals, produced on average of 793 kg of milk with 4.52% butterfat in 280 days.

Record figures in butterfat production were booked by Willie 2-2280 K.S., owner C. Verrips, Stolwijk. This four-year-old goat produced 1,990 kg of milk with 6.33% butterfat, which is 126 kg of milkfat in 302 days. This is probably a world record.

Export of breeding pigs to Greece

Following a trial shipment of 40 head, 400 young breeding pigs were shipped to Greece last June. A second shipment of this kind will take place in the autumn.—Agricultural Newsletter from The Netherlands, November 1965.

POST-GRADUATE SOIL SCIENCE TRAINING COURSE

The International Agricultural Centre, in co-operation with the Agricultural University and the Soil Survey Institute, all three established at Wageningen-Holland, will hold a Post-graduate Soil Science Training Course at Wageningen, from January-July/September, 1966.

The course will start in January 1966 and will consist of two parts viz. a *general* (A) and a *specialized* section (B).

The general section (A) will last about three months and the specialized one (B) from four to six months.

A. The general section will consist chiefly of lecture courses covering the fundamental aspects of soil science. The lectures comprise:

1. Pedogenesis and soil classification
2. Soils in different regions
3. Soil chemistry
4. Soil physics
5. Study and description of the soil profile
6. Soil fertility
7. Soil and land classification surveying.

B. The specialized section will be held immediately after the general one. It is divided into two parts viz. one covering soil classification, land classification, and soil survey and related subjects (B1), whereas the second part (B2) deals with soil and plant analysis and soil fertility.

More details of the above-mentioned two parts are given below:

Soil classification, soil survey etc. (B1)

1. A two-months' course in aerial photo interpretation (see Newsletters of January 1962 and April 1963).
2. Different land types and land forms; the regional distribution of soils in relation to geomorphological/physiographical features.
3. Soil and plant growth; ecology.
4. Cartography for the production of soil and land classification maps.
5. Selected chapters from soil science.

Soil and Plant Analysis, etc. (B2)

1. Extensive laboratory instruction
2. Physical soil analysis: determination of moisture characteristics and transport coefficient; characterization of soil structure
3. Chemical soil analysis: determination of cation and anion absorption characteristics, pH-titration curve, analysis of saline and alkali soils
4. Soil fertility analysis: determination of available nutrients: soil teating and crop analysis.

Additional lectures will be given on:

5. Interpretation of soil test data
6. Design of fertility experiments (pot and field experiments).

Requirements

Candidates for the course should have a University training in agronomy, soil science or ecology with an M.Sc. degree or an equivalent diploma. In some special cases B.Sc. graduates with adequate experience in soil science may be admitted.

All courses will be delivered in English and for that reason participants must be fully conversant with the English language.

Applications and Admissions

Applications for admission must reach the supervisors before December 1st at the latest.

Questionnaires may be obtained from the International Agricultural Centre, 1 General Foulkesweg, Wageningen, Holland.

Fees

For the general section (*A*)

Dfl. 600.–/E. £ 60.–/US $167.–

For the specialized section Soil Classification (*B*1)

Dfl. 1290.–/E. £ 120.–/US $334.–

For the specialized part Soil and Plant Analysis (*B*2)

Dfl. 800.–/E. £ 80.–/US $224.–

Board and Lodging

Participants will have to provide for their own hotel accommodation. The Organizing Committee will gladly assist participants in obtaining this accommodation, and will provide, on request, addresses of hotels and boardinghouses with prices and other particulars.

For further information please communicate with: International Agricultural Centre, 1 General Foulkesweg, Wageningen, Holland.—Agricultural Newsletter, The Netherlands, December 1965.

TWENTY-FIVE POINTS FOR PROGRESS*

1. Recognize the family type farm as the keystone of India's democratic structure as well as agricultural structure. Recognize its moral and spiritual virtues.

2. Preserve and protect the integrity of the owner-operator-manager farmer.

3. Gurantee full land ownership with freedom under law by way of incentive to sound land management and land development.

4. Modify regulations/laws prohibiting leasing or renting/using any Government-owned lands for crops in short supply.

5. Water and land policies of India are haphazard, erratic and often contradictory. The nation can no longer delay a serious study of the conservation and utilization of the natural resources, especially in regard to water and land.

6. Enable the farmers to earn a return for their labour, management risk and investment which bears a reasonable relationship to that received for these same economic factors in any other segment of our economy, as well as adequate compensation for their contribution to the general welfare.

7. Protect farmers from economic aggression arising from extreme market fluctuations, caused by speculation, manipulation of market and distributive systems.

8. Provide protection against excessive losses to producers due to unforeseen and unavoidable causes; and thereby promote economic stability of India and at the same time, insure that food needs of the nation are met.

9. Increase farmer producer's bargaining power; which is inherently the poorest.

10. Improve rural health and education, improve security of the family type farm, strengthen co-operatives, expand research, improve marketing, strengthen rural communities, enhance rural living.

11. Continue to support and improve programme to process/utilize farm products close to the land.

12. Initiate and implement programmes to reinvest wealth employed or generated in farm or farms for agricultural developments. Stop mopping off of wealth employed or produced on farms by direct and indirect taxation means which leaves land barren and ruins present and future.

13. Initiate and implement with help of aircraft/modern means a programme on all-India basis to eradicate insects, worms, pests, etc.

14. Provide and expand educational programmes meetings the demands of an increasingly

*Suggestions published in "Aryaswapatra," Farmers' own Bulletin, Vol. II, No. VI, December 25,1965.

complex agriculture agri-business structure.

15. Provide adequately powered "clear channels" radio stations, services to the millions of Indians living in rural areas and "know-how."

16. Stop import of foodgrains which may depress farm prices below international levels.

17. Economic stability depends upon an expanding and profitable economy. Current fiscal policies have depressed agricultural production.

18. Indian agricultural labour, investors and producers should over any reasonable period of time, fare equally well with non-agricultural classes.

19. For providing preferential benefits to a small class of industrial labour number, large rural population should not be made to suffer.

20. Avoid any monopoly control—whether exercised by an individual corporation, a labour union, a state or any other organization.

21. There is no moral, economic or political basis for singling out and penalising Indian agriculture for favouring non-agricultural sectors.

22. Drastically chop off by at least 50% the heavy cost of Government administration, and thus reduce the burden on the poor. Government should not spend a paisa if it does not produce 1.2 paise in terms of negotiable/real wealth. Leave the paisa with the man who can produce 1.2 paise of real wealth.

23. Government should withdraw from business which can feasibly be operated by private enterprise.

24. As a policy, push authority and decision making close to the place of action. This policy would support the freedom of State and local Government from encroachment by Federal Government.

25. Government is urged that the next and future appointees to all positions related to agriculture shall be persons who can truly represent the interests of agriculture.—"Aryaswapatra", Farmers' own Bulletin, Vol. II, No. VI, December 25, 1965."

NEW O.E.C.D. PUBLICATIONS IN RELATION TO AGRICULTURE*

Organization for Economic Co-operation and Development

BOOKS PUBLISHED

I. Agriculture and economic growth

A Report by a group of experts

This report is published under the responsibility of six distinguished independent economists, appointed to study the adjustments needed to increase farm incomes while maximising productivity in the economy as a whole, and to examine the rate at which manpower should move from agriculture to other sectors of the economy.

Main headings of the report are:

1. Agriculture's role in economic growth.
2. Recent developments of OECD Member countries.
3. Future prospects.
4. Policy issues and possible lines of action.

*The O.E.C.D. Observer, Volume 9, December, 1965, page 64.

The report concludes that policies must increasingly recognize the needs for adaptation of agriculture to current and future economic conditions, and indicates measures which could help this adaptation both at national and international level.

120 pages: $3.00, 17s. 6d; F 12.00.; Sw. fr. 12.00; DM 10.00.

II. Interrelationships between income and supply problems in agriculture

This report was prepared by the OECD's Working Party on Agricultural Policies. It analyses the ways in which the efforts of farmers to raise their incomes, together with the trend to fewer but larger farms, may affect the pattern and volume of agricultural output. It concludes that improvements in farm structure should make it easier to adjust supply to demand.

The report also examines the various possible means of controlling supply, including price policy, quotas, land retirement, etc.

Main headings of the report are:

1. Basic trends affecting income and supply situation.
2. The adjustment of supply and demand.

156 pages: $5.00; 30s.; F.20.00; Sw. fr. 20.00; DM 16.50.

CALENDAR OF MAIN EVENTS AT OECD IN 1965*

Organization for Economic Co-operation and Development

February 15-18	..	Meeting of the Agriculture Committee.
June 17-18	..	Fourth meeting of the Committee for Agriculture at Ministerial level.
October 26-27	..	Meeting of the Committee of Agriculture.

GRAIN-MOVING DEVICE WINS AWARD AT ROYAL SHOW

A simple solution to a problem which has harassed the world's farmers for many years gained the premier award for new equipment at the Royal Show at Stoneleigh Abbey, Warwickshire, on (July 6, '65).

It is a non-mechanical device for emptying grain from all types of flat-bottomed storage silos.

In normal practice, grain leaves a silo by gravity flow. This means that several tons are left at the back and sides of the silo and have to be cleared manually.

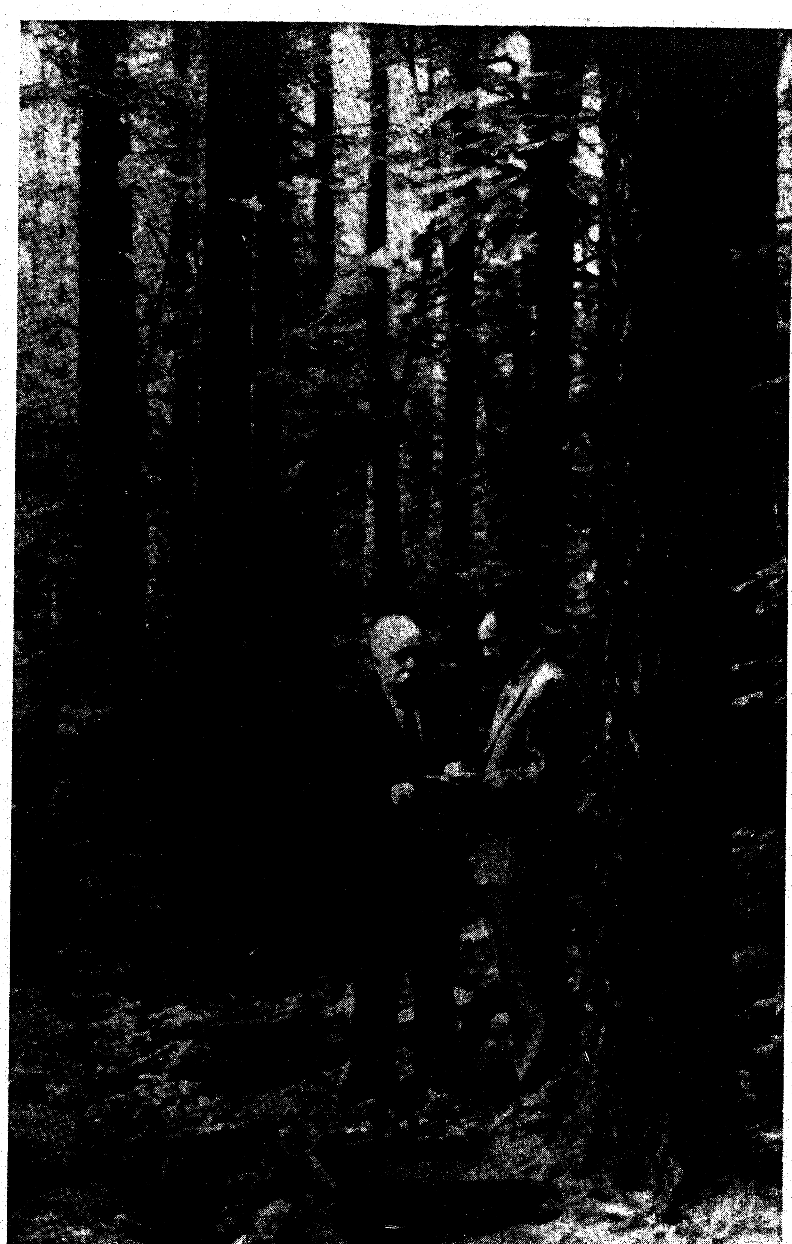
The new device is an air sweep which blows all the grain through the silo outlets across a raised floor of expanded metal mesh. Air from a conventional fan is blown under the metal floor and through the mesh until the silo is absolutely clear.

2,000 Units in Use

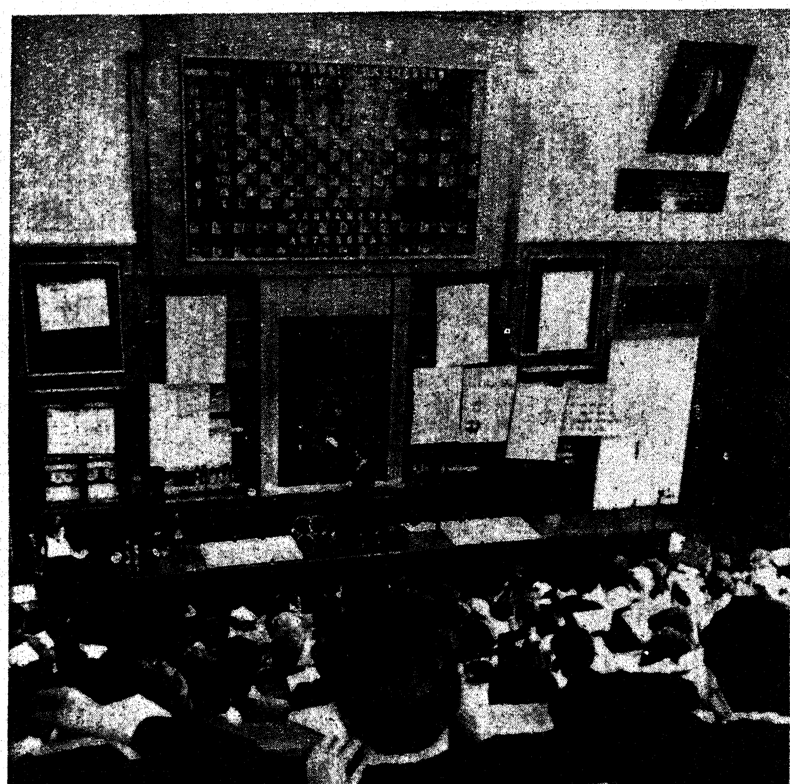
The device, which may be fitted to any type of square or round silo, was developed by a Cambridge firm. More than 2,000 units have already been installed everseas since the device went into production four months ago.

Power farming is the basic theme of the vast machinery section at the Royal Show. Manufacturers have concentrated on equipment which makes maximum use of the greatly increased power factor in modern tractors. This has led to many developments in equipment for potato harvesting, mowing and seed drilling—all at higher speeds.

* O.E.C.D. Press Release Press/A(65)69, Paris, 29th December, 1965.



2. A large-scale research work on forestry is being conducted at the experimental wood plot of the academy. This is one of the Soviet Union's oldest research centres. The total area of the wood plot is about 250 hectares. 220 of which are covered with wood. The research work here is guided by prof. V. Timofeyev (left), well-known scholar in forestry.



4. This largest agricultural college teaches some 3,000 students, over 500 post-graduates and trainees, 60 of which are representatives of foreign countries.
Photo shows a lecture at the organic chemistry chair.

One of the most forward-looking demonstrations at the four-day show reveal how computers can be used simply and cheaply to help farmers reap the maximum benefit from their efforts.—British Information Service. 739.

BACTERIAL PROTECTION OF PLANTS*

V. SAVZDARG, Agronomist

The biological method of plant protection has recently become very popular with Soviet state and collective farmers. Based on the use of natural enemies of pests and parasites and of pathogenic bacteria, this method is superior to many chemical, agrotechnical and mechanical techniques.

By means of the biological method, the Soviet Union has eliminated the threat of explosive growth of the wooly apple aphid, and pests of many agricultural crops. Aphelinus, the natural wooly aphid parasite, is now spread in many areas of the country and effectively prevents the pest from getting out of hand. Whereas, in order to check the multiplication of this aphid, chemically, over the orchard area of 100,000 hectares, about a million roubles would have been required annually.

Larvae of the corn borer were found on large areas under maize in the Kommunist Collective Farm in the Sumy Region. That threatened a real disaster: by spreading itself the pest could devour all the maize crops.

Natural enemies of the borer—egg-eaters of Trychogramma—were released into the fields, and they quickly destroyed the larvae. The results were excellent: in the autumn the collective farmers obtained 35 metric centners of maize grain from a hectare—much more than from untreated areas. The biological methods of pest control have proved to be 1/13 as expensive as the chemical dressing of the fields is.

GOOD RESULTS

Recently, the USSR Research Institute of Plant Protection has obtained entobacterin. A gramme of the dry preparation contains up to 30,000 million bacterial spores and the same number of toxic protein crystals. Entobacterin has no harmful effects on man, warm-blooded animals, bees and plants. It can be applied in any phase of plant development: in the flowering stage and before harvesting. The preparation gets into the insect organism together with food. When sprayed on plants, it kills more than forty-five pest species. The preparation is employed against different moths, white butterflies, pierid butterfly, silkworm moths, winter moth, potato bug, American white butterfly, apple worm, gooseberry moth, sawflies and other insects. Very good results are given by the combined use of biological preparation with a small dose of chemicals.

The Ukrainian Institute of Plant Protection has used the preparation boverine together with DDT against the Colorado potato beetle. The spraying killed almost all the larvae of the pest.

It is common knowledge that rodents—mice, rats and field mice—do great damage to crops. The bacteriological method can be of inestimable value here, too. The mocro-methods

*"Soviet Features" Vol. IV No. 275, Dec. 65 Information Deptt. of the USSR Embassy in India, New Delhi

laboratory of the USSR Institute of Agricultural Microbiology has obtained pathogenic strain No. 5170 that causes typhus in mice rodents. It is now employed in various parts of the Soviet Union. In Byelorussia it was used against the water field-mouse. On the tenth day of application all the mice were fully decimated. The effect of bacteria lasted three to four months. It took one-fourth as much money and effort as in chemical treatment. The farms of the Sargat district of the Omsk region used the bait against mice rodents at warehouses and in animal sheds. They were placed at strategic places, in holes and feed boxes, a gramme per square metre. Rats and mice died on the third-fifth day.

BEATING POTATO CANCER*

MARK MILKHIKER

Potato cancer is a subject that has been studied at the USSR Research Institute of Potato Cancer at Chernovtsy, the Ukraine, for many years. Its lathogenic agent is a soil-inhabiting fungus causing morbid growth of the tissue in the form of cancer knots which quickly begin to rot and destroy the tubers.

It was established at the physiology and biochemistry laboratory that susceptibility to the diseases depends on the biochemical peculiarities of tuber proteins. It is here that the cancer pathogen breaks in, enhancing growth and cell division. The affected cells give rise to subtances which stimulate the rapid growth of cancer knots. The proteins of stable and the canceresistant potato varieties are biochemically different. Noticing this fact the staff of the laboratory have devised techniques of the rapid diagnosis of the disease.

In collaboration with the Institute of Chemical Physics of the Soviet Academy of Sciences the station is looking for substances that inhibit the growth of cancer cells. It has already been proved that propylgallate, for example, by reducing the activity of enzymes, or biological stimulants of chemical reactions, retards the formation of cancer growths.

SIMILAR MECHANISMS

Perhaps there is some resemblance between cancer growths in plants and animals? After all, there is a whole number of substances causing cancer growths in both animals and plants. This, of course, does not suggest that plant cancer is identical to the malignant tumours in man and animals, but it may be that the mechanisms involved in the growth of tumour cells are similar.

Is it not possible to treat plants with substances that help man and animals to combat the disease, for instance, with sarcolysine and embikhine?

The experiments of the physiology and biochemistry laboratory have shown that these substances can fully inhibit the growth formation processes in potatoes without causing any damage.

Scientists have studied the ability of different substances to enhance or to retard the growth of tumours. Thus, potassium salts raise cancer resistance, while weak solutions of substances inhibiting the respiratory growth processes completely prevent the disease. At the same time some growth stimulants, for instance, boron, increase susceptibility to the disease.

*"Soviet Features" Vol. III No. 275, Dec. 65. Information Department of the USSR Embassy in India, New Delhi.

CENTENARY OF MOSCOW AGRICULTURAL ACADEMY

PROF. IVAN SHATILOV*

The Moscow Agricultural Academy named after K. A.Timiryazev, formerly the Petrovsky Academy, was established 100 years ago, on December 3, 1865. At first it trained managers of estates and officials of state machinery. Later, from 1872, it became an ordinary educational institution for district agronomists.

A new period in the Academy's activities began after the October Socialist Revolution. Its curricula and teaching methods were reorganized, and its lecture-halls were filled with children of workers and peasants. In 1920 a Workers' Faculty was opened under the Academy. Specialization was introduced in the students' education. Lectures in its 57 departments are delivered by prominent scientists.

EXPERIMENTAL FARMS

Knowledge gained by the students in the Academy is consolidated further on its experimental farms, located in Saratov, Tambov, Yaroslav and Moscow regions. These farms occupy an area of over 26,000 hectares, and have 8,000 head of cattle, many sheep, pigs and poultry, The crop yields are here double those received by neighbouring collective farms and state farms. In 1964 the Academy's farms netted a profit of 800,000 roubles. Each of them has laboratories, where the students engage in research work.

The successes of present-day physics, mathematics, chemistry and other sciences have influenced the level of training of agricultural specialists. Among the subjects studied here are applied atomic physics and radiochemistry, chemical means of plant protection, and a new course in cybernetics of living nature, which is being organized at the Academy.

The students are also acquainted with the methods of polarography, chromatography, spectrophotometry, electronic microscopy, thermography and roentgenoscopy.

The Academy has various equipment at its disposal, including electronic computers.The skills acquired here help the students in using these machines in their future work. Even in such a branch of science as phytopathology, the application of punched cards has raised the level of the students' knowledge, and taught them to determine the numerous plant diseases correctly.

During the past century more than 400 text-books have been written by the Academy's professors and teachers for agricultural institutes and technical schools, 50 of which have been written in the past five years alone.

SCIENTIFIC RESEARCH

The Scientists of the Moscow Agricultural Academy are at present engaged in 15 major problems covering some 100 subjects. Thus, plant physiologists have established new regularities in the important process of photosynthesis. With the help of bio-currents of plant organisms, a study of the "intimate" sides of their lives can be made.

The scale of scientific research going on here can be judged by the following figures. During the period of 1960-65 more than 600 works of the Academy's scientists have been registered at the Committee for Inventions and Discoveries of the USSR, and they received 52 certificates. Up to 800 scientific articles are published in periodicals annually.

*Rector of Agricultural Acade.

Much attention is given to training young scientists. Over 500 graduates and probationers, including 60 from abroad, engage in post-graduate studies. From 160 to 170 people defend their theses at the Academy annually. About 600 Candidate of Science Degrees and 100 Doctor of Science Degrees have been conferred here in the past five years.

Specialists of collective and state farms extend their knowledge in courses at the Academy. Lectures were attended by 2,700 agronomists and zootechnicians in this year alone.

Beginning as a small educational institution, the Academy has developed into a major educational and scientific centre of agricultural science in the years after October Revolution, having trained 43,000 specialists during that period. Its graduates work in all parts of the country. Many of them --called Heroes of Socialist Labour A. Lorkh, V. Pisarev, L. Zhadnov, Professors V. Sazonov, Y. Peive and A. Sokolov—have made a big contribution to agricultural and biological sciences.

Much has been accomplished by the Academy for the progress of agricultural science in the USSR. A century of creative work is left behind and broad prospects lay ahead.

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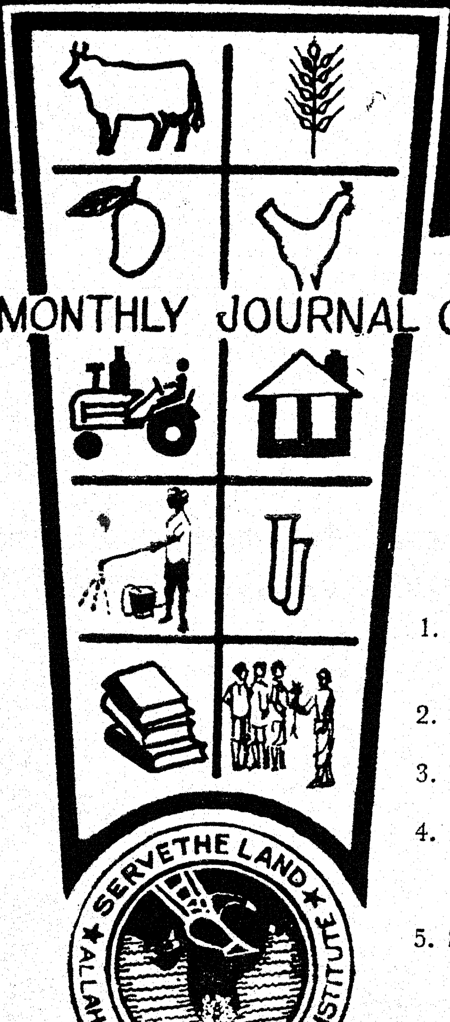
THE ALLAHABAD FARMER

A BI-MONTHLY JOURNAL OF AGRICULTURE & RURAL LIFE



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ALLAHABAD, U.P.

Suggestion for Contributors to The Allahabad Farmer

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Maturity Tests for Fresh Fruits of Mosambi, Sweetlime and Grapefruit

B. P. SINGH[1] and I. S. SINGH[2]

In India, the fruits of grapefruit, Mosambi and Sweet-lime are being supplied mainly to fresh market. In most cases, fresh market affords the growers an opportunity to dispose off their fruits of high external and internal quality.The supply of poor quality and non standardized fruits to market is the result of lack of maturity standards. Secondly maturity test which is based on physico-chemical characterstics are designed to keep off the market from green, raw, immature and un-uniform fruits.

In U.S.A., especially in Florida, the maturity standards have been formulated and growers sell their fruits to Cannery based on pound of solids. In this way, they do not sacrifice the profit due to poor shape or colour and on the other hand, they pick the fruits on right time before certain fruits undergo changes in juice contents, sugars, acidity and flavour. It is to remember that quality must be obtained while the fruits are still on the tree because citrus fruits contain little or no starch and will not ripen after they are harvested.

Soule and Lawrence (3) have described the maturity tests for fresh fruits in Florida. At present, we do not follow maturity standards which results in the shipment of un-standardized fruits of poor quality. Therefore, this study was undertaken to formulate maturity standard of grapefruit, Mosambi and Sweetlime at Allahabad, Uttar Pradesh, India.

MATERIAL AND METHODS

A composite sample was taken randomly from the commercial citrus orchards of Allahabad Agricultural Institute, Allahabad at the interval of two weeks. The following factors were considered for maturity standards: Average weight and diameter of fruit, colour break, percent juice, total soluble solids (T.S.S.), total acidity and T.S.S./Acid ratio. The following procedure was used:

[1]Horticulture Department, Allahabad Agricultural Institute, Allahabad.

[2]Research Asstt., Horticulture Department, Agricultural Institute Allahabad.

Colour break:

A representative sample of 25 fruits was taken before the dark green colour of immature fruit is changed by nature to required colour of rind. Each fruit is compared with a standard colour disk (1). At least 75% of the fruit in the sample must be the required colour break.

Juice content:

The juice was extracted by hand and fruit reamer. There was no significant difference in the percent of juice by either of two methods of extraction. Therefore, in the whole experiment, juice was extracted by hand and strained through a double layer of muslin cloth. The juice was measured and expressed in percent by weight. Hand method was used especially because the fruit reamer is costly and the growers can not afford to keep it for maturity tests.

Total soluble solids:

It was measured by means of hand refractometer

Total acidity:

It was measured by titrating 10 cc. of juice with O.I.N. sodium hydroxide using phenolpthaline indicator.

Experimental results:

The fresh fruits of sweetlime, Mosambi and grapefruit were analysed periodically at the interval of 15 days. The data are table 1, 2 and 3.

A. Sweet lime: Data regarding the changes in fruit and judging them for maturity is in table 1.

TABLE 1—*Maturity requirements for sweetlime*

Date	Average weight of fruit (Cm.)	Average Diameter of fruit (Cm.)	Colour Break	Percentage juice	T.S.S. (%)	Total Acidity (%)
6th August, '65 ..	41.30	4.16	13%	32.5	9.86	0.072
21st August, '65 ..	71.80	5.23	21%	36.7	9.80	0.068
6th September, '65 ..	142.00	6.28	49%	42.6	10.00	0.066
21st September, '65 ..	159.00	6.50	78%	51.3	10.40	0.064
6th October, '65 ..	156.70	6.52	79%	47.0	9.80	0.062

Data of table 1, revealed that optimum requirements for maturity of sweetlime were obtained in the month of September. Afterwards the amount of juice and total soluble solids started to decrease. The best picking time was the 2nd and 3rd week of Sept. in respect of colour break, yield of juice and total soluble solids per acre for fresh and processing industry.

B. Grapefruit variety Saharanpur special: Data regarding maturity test of grapefruit variety Saharanpur special are in table 2.

TABLE 2—*Maturity requirements for grapefruit*

Date	Average Weight of fruit (Cm)	Average Diameter of fruit (Cm)	Colour break	Per cent. juice	T.S.S. (%)	Total Acidity (%)	TSS/ Acid ratio
11th Aug. '65 ..	155.1	6.84	17%	22.7	10.2	1.49	6.8:1
13th Sept. '65 ..	371.6	9.10	30%	28.0	10.8	1.16	8.5:1
12th Oct. '65 ..	402.3	9.70	72%	30.0	10.6	1.20	8.8:1
1st Nov. '65 ..	470.6	9.76	78%	36.0	10.8	1.15	8.5:1
15th Nov. '65 ..	492.0	10.20	85%	42.0	11.6	1.02	11.3:1
3rd Dec. '65 ..	583.7	10.40	85%	47.0	12.1	0.95	12.7:1
17th Dec. '65 ..	688.6	10.90	87%	40.0	11.8	0.88	13.4:1
1st Jan. '66 ..	685.4	10.82	85%	38.0	11.0	0.91	12.1:1
16th Jan. '66 ..	670.3	10.93	88%	36.0	11.1	0.89	12.4:1

Maturity requirements for fresh fruit shipments and for processing industry are given in table 2. Most of the fruits start to change the colour towards Empire yellow (P19, K3) from October. The best time to harvest fruits is, from 15th November to 17th December as indicated by high percent juice and T.S.S./Acid ratio. Grapefruits have a high retention capacity and they may be left on tree till the end of February but data (2) indicated that this practice effects the next year's crop adversly. Therefore, it is advisable to harvest the grapefruits when they attain the maturity.

C. Mosambi: Maturity requirements of Mosambi are in table 3.

TABLE 3—*Maturity requirements for Mosambi*

Date	Average Weight of fruit (Cm)	Average Diameter of fruit (Cm)	Colour break	Per cent. juice	T.S.S. (%)	Total Acidity (%)	T.S.S./ Acid ratio
7th Sept. '65 ..	115.0	5.90	12%	42	9.3	1.03	9.03:1
2nd Sept. '65 ..	123.5	6.40	38%	51	9.5	0.78	12.1:1
6th Oct. '65 ..	145.0	6.70	61%	52	10.0	0.76	13.1:1
21st Oct. '65 ..	162.2	6.78	73%	51	9.8	0.79	12.4:1
5th Nov. '65 ..	160.7	6.80	78%	46	9.7	0.79	12.3:1
20th Nov. '65 ..	152.0	6.70	75%	43	9.8	0.77	12.7:1

Data of table 3 indicates that the fruits of mosambi attain the required maturity in the month of October. In last week of September the total acidity decreases and afterwards there is not a marked decrease or increase in acidity. Amount of juice starts to decrease from November without any change in T.S.S./Acid ratio which may contribute significantly to the processors which will loose the amount of total soluble solids per acre on account of less juice. Therefore, it is more in the interest of processors that they pick the fruit at right maturity period to avoid any quantitative loss.

SUMMARY

Maturity tests of Mosambi, Sweetlime and Grapefruit are utilized to provide information on the progress of maturity in order to facilitate the growers to pick the fruits at right maturity period and processors to collect the fruits at right time without any loss. Maturity tests are based on five factors a colour break caused by nature, amount of juice, total soluble solids, total acid and ratio of total soluble solids to total acid. The following are the optimum maturity requirement of grapefruit, Mosambi and Sweetlime at Allahabad Agriculture Institute, Allahabad which may be applied to adjacent Citrus orchards:

Name of fruit	Colour break	Per-cent. juice	% T.S.S.	% Acid	T.S.S./ Acid ratio	Maturity period
1. Sweet-lime	78%	51	10.4	0.064	..	Middle of September.
2. Grapefruit ..	85%	45	12.0	0.95	12.6:1	Mid. Nov.-Mid. Dec.
3. Mosambi ..	75%	50	9.8	0.79	12.4:1	October.

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Storage of Vegetables

Man Singh Manohar*

INTRODUCTION

Storage of vegetables is considered to involve holding the product essentially in its original form, generally at reduced temperature and high humidity. This definition excludes preservative processes in which the form of the product usually is altered. Generally freezing is also discussed in preservation.

Storage of vegetables is of great importance. It tends to stabilize prices by carrying over produce from periods of high production to periods of low production, thus it avoids gluts and market stagnation with consequent loss to the producer. In an area vegetables mature only in their respective seasons, but people generally like them to eat every week of the year. Good nutritional standard requires a constant supply of vegetables. One of the means of spreading the supply of vegetables throughout the year is storage of vegetables.

With most vegetables, the main need of storage is for short periods in many cases for a few weeks only.

FACTORS GOVERNING STORAGE

Vegetables, even after harvest, are living plant parts which require Oxygen, give off Carbondioxide and other products of respiration, and generate heat.

Some chemical changes also take place in storage e.g. in Parsnip at 1°C starch is changed to sucrose thus improving the quality, Carrots deteriorate in quality due to slow loss of sugar in respiration; likewise in Celery at 0°C active ripening process goes on, later cells break resulting in decay of more resistant pectic compounds into less resistant pectic compounds.

By means of investigations carried out by United States Department of Agriculture, the following factors were found which govern the successful storage of fresh vegetables:—

MAJOR FACTORS

Temperature:

Temperature is of primary importance in storage. Specific rules regarding the optimum temperature conditions for storage that may apply to all products can not be given since the requisites of various vegetables as given by Knott (1955) in "Vegetable growing" by Thompson and Kelly (1957) in "Vegetable Crops" by Barre and Sammet (1950) in "Farm Structures". The following general recommendations regarding average storage temperature, humidity and duration of produce may be considered here.

The general effect of lowering the temperature of vegetables or fruits is to slow down the various changes which take place after harvesting of vegetables all of which result in the ultimate decomposition of material. These changes occur more rapidly during storage at high temperatures than at low temperatures. It, therefore, follows that the lower the temperature

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Serial number	Vegetables	Temperature (°C)	Humidity (%)	Approximate storage periods (Months)
1	Asparagus	0	80—90	1/3
2	Cabbage	0	90—95	5-6
3	Carrot	0	92	5-6
4	Cauliflower	0	85—90	1
5	Egg-plant	10—13	85—90	$\frac{1}{2}$
6	Garlic	0	70—75	6—7
7	Onion	0	70—75	6—7
8	Pea	0	85—90	$\frac{1}{2}$
9	Potato	2.2—4.4	85—90	5—6
10	Pumpkin	10—13	70—75	5—6
11	Spinach	0	90—95	1/3-$\frac{1}{3}$
12	Tomato (Ripe) ..	7—10	80—85	1/3

of storage, the longer would be the storage life of the material stored. There is however, a limit to the lowering of temperature below which the metabolism of the vegetables are disorganized resulting in the physiological injuries such as failure to ripen, when removed to higher temperatures, development of pittingon the skin change in colour, and internal break down. The determination of proper temperature is, therefore, a very important factor in successful storage of vegetables.

Humidity:

Proper humidity of the storage room varies with the crops. According to Watts and Watts (1951) and Knott (1955), Pumpkin, Squash, Onion, Sweet potatoes and Garlic keep best in dry atmosphere i.e., 70 to 75% relative humidity. But root crops and cole crops, infact, most vegetables, require relatively high humidity i.e., 90 to 95%, to preserve their plumpness and succulence to avoid shrinkage. Too high a humidity without compensating low temperature may favour decay, sprouting and rooting; while too low humidity will result in wilting of the vegetables.

The humidity of common storage can be increased by sprinkling the floor or by admitting moist air from out side. Though not common in India but "Humidifires" of various types are used sometimes in Western countries in cold storage. Excess moisture can be taken out from air by blowing it over a drying agent such as Calcium Chloride.

Ventilation:

Ventilation is necessary to supply Oxygen and to remove Carbondioxide and other respiration products, moisture, and heat liberated by the vegetables. Both temperature and

humidity in a non-refrigerated storage are regulated to some extent by ventilation. In cold storage, where temperature can be kept low, relatively little ventilation is required.

The amount of ventilation will be determined by the type of storage and crops to be stored i.e. broccoli is stored in Oxygen free atmosphere to prevent the loss of Chlorophyll. Generally excessive ventilation results in wilting and shrinkage and inadequate ventilation is characterized by the decay of leafy crops, early sprouting of root crops, and development of Black-heart of Potatoes.

Condition of crop:

Many vegetables possess better keeping quality when placed in storage just before they have fully matured. This is particularly true of Cole and Salad crops. Onions keep better when harvested promptly at maturity. Potatoes and Squashes should be fully matured. Over maturing is undesirable in root crops as they are likely to be even more woody when taken out of storage.

MINOR FACTORS

Losses in storage often are due to diseases, and insect pests which have developed in field, and fully handling from field to storage house. When such infections are known to exist and to be a common source of trouble in storage, the safer side is to dispose off the crops without attempting to preserve it for later marketing. Unusual care should be exercised to control diseases, as well as insects which may open the way for decay, on crops that are intended for storage.

In planting vegetables for storage it is important to select varieties that are well suited to the purpose, as indicated in the variety descriptions contained in the catalogues of reliable seedmen. For detailed information (Baily, 1947) the Standard Cyclopedia of Horticulture may be referred.

TYPES OF STORAGE

Different authors have dealt the types of storages by taking into consideration one of the following as the basis of classification of different types of storages e.g. time, location, and means of storage etc. The following is the summarised classification of different types of storages.

Types of storage
- Above ground storage
  - Dry or common storage
    - Common storage
    - Mounds
    - Other types
  - Cold storage
    - Ice refrigeration cold store
    - Mechanical refrigeration cold storage
- Under ground storage
  - Dry or common storage
    - Pits and trenches
    - House celler
  - Cold storage
    - Ice refrigeration cold storage
    - Mechanical refrigeration cold storage

DRY OR COMMON STORAGE

They may be of two types i.e. Underground or above ground as confirmed by their situation.

The term "Common storage" is applied to those types of storage in which the use of Ice or Mechanical refrigeration is not made, and the cooling effect is being obtained from the natural low temperature of the out-door air. The aim of common storage is "to conserve the natural cold" in buildings which are specially constructed and equipped with proper ventilation devices. The following are the different types of above ground common storages:—

1. *Common Storage*

These are non-refrigerated above ground structures. They are used to store those vegetables which may be stored safely in a wide range of temperatures, as in such types of storages the temperature and humidity fluctuates according to the prevailing atmospheric temperature and humidity.

Such stores are used to store onions, sweetpotatoes, and to a limited extent for squashes, melons and cabbages. Details of construction and shape vary with the climatic conditions of a particular area and with different crops therefore a general size and shape can not be given.

2. *Mounds*

Roots can be handled more easily is mounds. A layer of straw is spread out on the surface, the carrots, beets etc. piled up, covered with 9 to 12″ layer of straw and a lesser thickness of soil.

3. *Other Types*

Above ground storage also includes the storage ot vegetables in Ice boxes, or electrically operated refrigerators of varying sizes according to the needs of quantity of vegetables to be stored. Both of these are practiced in cities.

There are other methods too for storage of vegetables which are though not good but are generally practiced in rural areas like storage in bags, or in heaps. Only crops like onion, garlic, potatoes and sweetpotatoes etc. can be stored by these methods.

At some places people also store vegetables like Brinjal, Squashes and melons etc. in water for short time but these are not general methods of storage.

COLD STORAGE

"Cold storage" is designated as artificially cooler storage, or the holding of the products in rooms or building which artificially refrigerates i.e. the cooling effect being brought by machinery or ice.

1. *Ice refrigeration cold store*

They are so called as the agent used for refrigeration are ice slabs. In such type of cold storage ice-slabs are made use to keep the temperature down, but in this case humidity can not be controlled successfully. Secondly this type is costly in long run and troublesome also as every now and then one has to replace the ice slabs in the place of melted ones.

Such cold-storages may be located above the ground or under ground, but care is taken to reduce the cooling effect to minimum. For this they are also insulated with insulation materials.

Ice refrigeration is made use in vehicles used for transport of vegetables in western countries, but such refrigerated transport of vegetables has not yet developed in our country. Here vehicles which are used for transport of vegetables are not generally refrigerated but only selves or other facilities are provided to keep the product in it without much mechanical injuries.

2. *Artificial cold store*

In this case the store is refrigerated artificially with the help of refrigeration plant, the function of which is to extract heat from the objects to be cooled and some arrangement is also made to regulate the humidity.

Such stores may be located above or under the ground but the best location is that, which reduces the loss of cooling effect to minimum. Such stores are also perfectly insulated with insulation materials.

General principle of working of refrigeration plant:

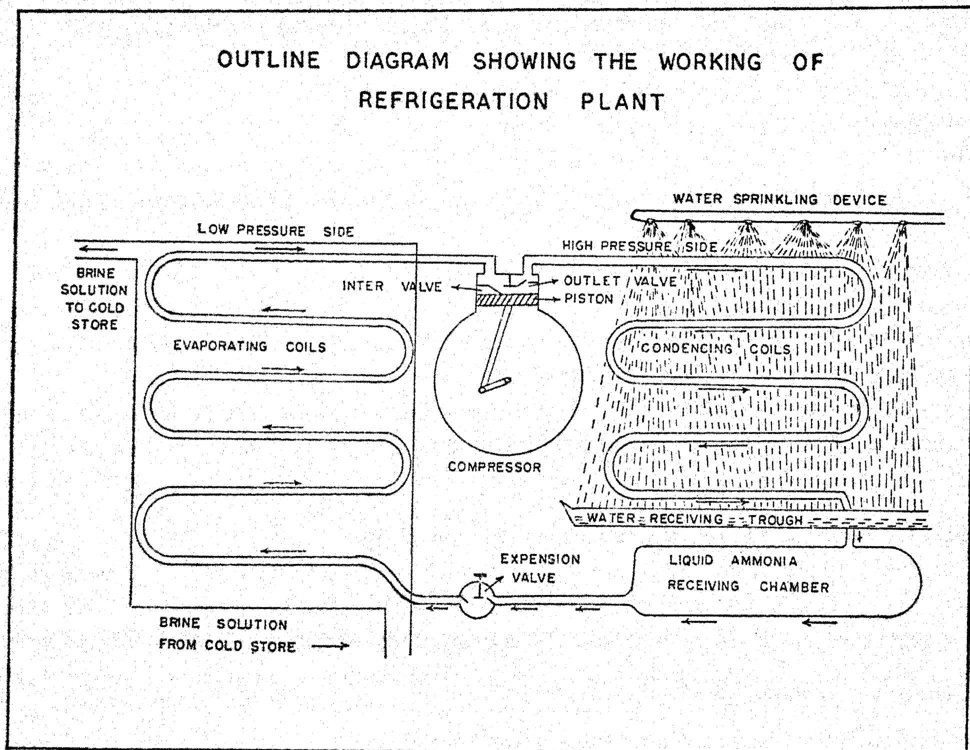
Suitable liquid refrigerant is allowed under high pressure to pass through expension valve to low pressure side (Evaporating coils) where the liquid refrigerant vapo-raises and takes the latent heat of vaporization, by absorbing surrounding heat, thus lowering the temperature of surrounding and bringing about the cooling effect; which is either directly brought to the cold store by placing evaporating coils in cold store or by cooling the air of a room and forcing that cool air to cold store or the cooling effect is taken through the use of refrigerating agent like brine solution etc.

The gasious refrigerant is again compressed to high pressure side (condencing coils) by compressor and is liquified by cooling the gas under high pressure by water. Again the liquid refrigerant (NH_3) is collected in ammonia receiving chamber and is compressed through expension valve and the cycle is repeated producing cooling effect. The following is the outline diagram of the working of refrigeration plant: (Fig).

This is most efficient type of storage to be used for vegetables. Almost every vegetable can be stored in it for a little or longer time according to keeping ability of vegetables, e.g. lettuce and spinach can be stored for comparatively shorter time than cabbage and cauliflower. While vegetables like potato, onion sweetpotatoes and garlic etc. can be stored for much longer time. Commercially potatoes are stored at the rate of Rs. 14.0/qu. for seven months in cold storage.

The outstanding advantage of cold storage is the ability to cool crops to desired temperatures within a few hours regardless of season and outside temperature. It is the most efficient type of storage but limitations to its use is the high cost of installation of refrigeration plant and some technical knowledge, both of which are unfortunately beyond the capacity of an average vegetable grower of India.

For detailed information Baily's "Standard cyclopedia of Horticulture" and Work and Karews' "Vegetable Production and Marketing" may be referred.



UNDER GROUND STORAGES

1. *Pits and Trenches*

Pits and trenches of varied types can be used for storage in field or garden, but their use commonly is decreasing due to certain shortcomings e.g. it can not control temperature, humidity and ventilalion. If at all it is used it is often a good scheme to have a number of small pits, so that the entire content may be removed whenever it is opened.

Pits and trenches of suitable types are used for storing roots; cabbage and celery etc. The advantages of pits and trenches is that very little capital is invested in storage of vegetables. But labour required for storing is great and removal of produce is often difficult.

2. *House cellar*

The cellar of the residence is often used to store vegetables. As a rule it provides unsatisfactory conditions, especially if it contains a furnace, because the air is then too hot and dry. This difficulty may be overcome to some extent by separating the storage room with suitable walls, and covering the pipes with asbestos. Ample ventilation must be possible and root crops may be covered with few inches moist soil.

USE OF CHEMICALS

Certain chemicals are used in storage rooms to speed up the rate of ripening vegetables. Lee and Caralus (1949) treated cauliflower with Naphthalene acetic acid to prevent leaf

abscession for increasing length of storage similar results were also obtained by 2, 4-D. In case of salad crops of 2,4-D Trichlorophenoxy acetic acid sprayed 4-5 days before harvest prevents the loss of chlorophyll.

Sanyer and Dallyn (1955) proved that irradiation of tubers with 10,000 Roentgers or Gama Rays kept potato dormant for more than a year.

Other Chemical like Methyl ester of NAA can be placed in storages, pits and cellars to delay sprouting of potato, carrots and other root crops. It is also possible to spray onions and potatoes with Meleic hydrazide before harvest to reduce subsequent sprouting.

CONCLUSION

In short the principle general requirements for storage of vegetables are (1) Low Uniform temperature; for most of vegetables just above 0°C, (2) High humidity with a few exceptions (3) Sound, disease free produce of proper maturity of suitable variety (4) Place that is; (*a*) well drained (*b*) Clean, (*c*) Vermin proof, (*d*) Accessible, (*e*) durable and (*f*) Cheap.

In India and other tropical countries storage of vegetables is difficult and so it is costlier as the average prevalent annual temperature is much fluctuating and much higher than the temperate countries.

Although we are fortunate enough to have varied climates at a time at different places which help to produce nearly all vegetables all round the year at one place or the other, so with increased better transport facilities the storage of vegetables for longer time will not be given as much importance as it is given in western countries. Nevertheless in India there is great necessity of installation of cold stores in markets to avoid gluts for short time.

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Lentil (Masur)

R. P. Singh and A. Aziz*

Origin and History

Lentil, the most nutritive of Indian pulses, has been under cultivation in this country since a long time. According to De Candolle[1] the plant originated somewhere in temperate Asia, Greece or Italy, and was first introduced to Egypt and then to European countries and India. However, Helena Barulina[2] is of the opinion that its centre of origin lies between Hindukush mountains and Himalayas where it was observed to grow in wild state.

Distribution:

Lentil is extensively grown in many countries, especially in the Mediterranean region, near east, France and India. In this country about two million acres are devoted to this crop, mostly in the northern part. Acreage and production in the various states of India is shown in Table 1.

TABLE 1. *Area and production of Lentil in different states of India*[3]

Serial number	Name of State	Area in thousand acres	Production in thousand tons
1	Madhya Pradesh	548	77
2	Uttar Pradesh	468	50
3	Bihar	372	62
4	Punjab	144	28
5	Maharashtra	35	5
6	West Bengal	34	6
7	Assam	8	1
8	Himachal Pradesh	5	1
	Total ..	1,879	272

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Refs.

1.

2.

3.

Botanical Description:

Lentil is a member of the sub-family papillionaceae of family leguminoseae. Linnaeus called it *Ervum lens*, other scientific name commonly used, is *Lens Esculanta Moench.* The plant is a herbaceous annual and resembles Bengal Gram both in habit and stand, the leaves however being smaller. Plants are profusely branched with weak stems, growing to 30 to 60 cm, and are usually angular possessing short hair, the degree of hairiness varying with different varieties. They may be entirely green or possess anthocyanin pigments at the base. Leaves are pinnately compound, stipulate having two to eight pairs of oval or linear leaflets, and terminate in a tendril. The leaflets are about 1 to 1.5 cm long, attached to the petiole by small pulvinus. Flowers are produced in the axils of leaves, usually in clusters of two or three. Flowers are white, voilet or pink in colour according to variety. Pods are very small, about 1 to 2 cm long, and contain two seeds, which are disc-like, brown and somewhat mottled.

Climatic requirement:

Lentil is a cold season crop in India. It is sown with the onset of winter season when the temperature ranges between 10 to 20°C. During the growing period the temperature goes down still lower but at maturity, a warm and dry weather prevails.

Soil:

Lentil is grown on a variety of soils, varying from alluvium of Punjab to the black cotton clay of Madhya Pradesh. It is suited even for soils of low fertility and slight alkalinity. However, well aerated low-lying light soils are most suitable for this crop. It is generally cultivated under rainfed conditions and like gram the crop thrives on sub-soil moisture. In some parts of the country a light irrigation is applied. On nitrogen rich soils excessive foliage is produced resulting in poor yield of grains. In Bihar it is grown in low-lying fields after the flood recedes.

Seedbed preparation:—

Lentil does well even on roughly prepared seedbed. However, the soil should be well-stirred and free of weeds. Clods need not be broken very fine since they facilitate aeration which is very important for lentil. In the heavy soils of Madhya Pradesh, five to six ploughings are given while in North India, only one or two serve the purpose. When it is grown in the standing crop of paddy, no ploughing can be done, therefore the seeds are broadcast or drilled in between the rows of paddy.

Sowing Time:—

Lentil may be sown with advantage in late October or first half of November when it is rather late to sow the longer duration crop of gram. It requires two to four *weeks less than gram* to complete its growth and development. In Uttar Pradesh, the crop generally follows early or medium rice, sometimes sown even when the rice has not been harvested. The sowing time along with seed rate and spacing in different countries is given in Table 2.

Sowing and Seed-rate:

It is most commonly sown by broadcast either as a sole or mixed crop. However, for adequate and uniform stand, line sowing is essential. In paddy areas, lentil is sometimes

TABLE 2. *Sowing time, seed rate and spacing of lentil*

L

Country	Sowing time	Seed rate	Spacing between rows
Lybia	Dec.—Feb. ..	30 Kg/hec ..	40 cm apart
India	Oct.—Dec. ..	35—50 ,, ...	Broadcast or 23 cm apart
U.S.A.	March	12—15 ,, ..	90—120 cm apart
France	Nov.—Feb. ..	30—150 ,, ..	25—30 cm apart

broadcast in the standing crop of paddy which is due to mature shortly. After paddy is harvested, it occupies the field. Such a crop of lentil is locally known as a *paira* crop.

Seed rate when grown as a single crop, varies between 30 and 50 kg. per hectare. When sown mixed with barley, mustard, etc., it is approximately 20-25 kg. per hectare.

Rotations and mixtures:

In India, it is grown either as a single crop or mixed with kusum and barley under unirrigated condition. In paddy area, it is broadcast in maturing paddy crop where it takes over after the paddy is harvested.

Manuring:—

As is the common practice with legumes, no manures are applied to this crop. However, phosphorus and potash may be applied for better yield and higher returns. In France 25 to 30 kg. of P_2O_5 and 40 kg. of potash is usually applied per hectare. India, 40 to 50 kg. of P_2O_5 may be applied to irrigated crop at the time of seedbed preparation.

Irrigation:

Lentil is usually grown without irrigation because irrigated lands are used for growing more profitable crops, like pea, which give higher yields of both grain and straw. However, 1 to 2 irrigations at the flowering stage would be very beneficial.

Interculture:—

After sowing, no interculture of weeding operations are done. However, it is sometimes necessary to weed out the vetch (Vicia spps.) which is associated with the crop.

Harvesting

The crop should be harvested before the pods are dry, to avoid shattering. The best time to harvest is when plants are yellow and seeds resist pressure when pressed between fingers. The crop is ready for harvesting within three to four months depending upon the variety and the time of sowing. Generally, it is harvested in February in Bundelkhand region and inMarch, in other parts of Uttar Pradesh.

Like other pulse crops, lentil is also harvested with sickle and is placed in small bundles for drying. Threshing is done by beating or treading by bullocks.

Yield:—

The yield of grain is about 500 to 600 kg. per hectare under rainfed conditions and 900 kg. per hectare under irrigation. The average yield of lentil in Uttar Pradesh is appreciably smaller than those of gram and pea, being 300 kg. per hectare. At the Research Farm, Kanpur the average yield of the better yielding varieties, like T.3 have ranged between 10 to 120 quintals per hectare, and has gone up to even 17 quintal per hectare.

Varieties:

*T.*3—It is a selection from Agra. It is a late but high yielding variety requiring about 140 days to reach maturity. Seeds are of medium size and pinkish grey in colour with mottling. Its average yield is about 16-18 mds. per acre.

N.P. 11—It is an early and high yielding variety suitable for Bihar and Eastern U. P.

T. 36—It is a late maturing variety (130-140 days). Seeds are small. This was the only recommended variety for the whole state of U. P. till 1959.

T. 6—It is suitable for all the (Gograghat conditions) floods affected areas of Eastern U. P. It is semi-spreading, possessing green foliage, early maturing, ready for harvesting in about 90 to 100 days.

T. 9-12—It is profusely branching, higher yielding than the local varieties possess good cooking quality and highly recommended for Punjab, to be sown in November.

B. 77—It is a selection from material collected from Jorhat, Assam. Plants are fairly tall and spreading and medium in maturity. Flower is white and the seed is ash coloured with dark spots over the testa. 1,000 seeds weigh 19.5 grams. The maximum and the average yields are 8.5 and 5.5 quintals per acre respectively. It is highly recommended for West Bengal.

N.P. Hyb.—It is an early yielding variety producing bold seeds and is recommended for U. P. and Bihar.

Insect pests and Diseases:

The crop is not subject to any serious pest or disease. In India, *Uromyces fabae* causes leaf rust which is not serious. In U.S.A., North Africa and France, lentil weevil (*Brucus lentil*) is a common pest.

Economic Importance:—

Lentil, the most *nutritive* among Indian pulses, has long been recognised as a very delicious "*dal*" for which it is mainly grown. It is also used as a component part of the dish called "*khichri.*" The straw of lentil is *highly rich in protein* and when mixed with cereal straw, makes an ideal feed for cattle. It enriches the soil and nitrogen like any other legume crop, but it has special significance in crop rotation because of its drought resistance and shorter growing period. Lentil is also considered to be an ideal food in Indian system of medicine, for patients of certain diseases.

Tips to Farmers:

Sow improved variety at the right time, using high seed rate, apply superphosphate, control weeds and irrigate once or twice at the flowering time, for producing a bumper crop of lentil.

Chemical Composition

Water	—	—	—	12.4%
Fats —	—	—	—	0.7%
Ash —	—	—	—	2.1%
Phosphorus	—	—	—	0.25%
Protein—	—	—	—	25.10%
Carbohydrates	—	—	—	59.7%
Calcium	—	—	—	0.13%
Iron —	—	—	—	0.002%

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Effect of Micro-nutrients on the yield of Phosphorus and Potassium by *Zea mays* (L)

M. L. VERMA*

Phosphates are vital in the story of life. As orthophosphate, it plays fundamental role in the activation of very large number of enzymes that depend upon phosphorylation. Potassium has important role in the photosynthesis and translocation of synthesized material. These are major plant nutrients along with nitrogen. Some nutrients occur in plants and soils in traces only, but they are essential for plant growth and nutrition of major elements. Rogers and Wu (1948) observed that zinc nutrition is linked up closely with calcium and phosphate supply. Martin *et al* (1953) observed that an excess of sodium or potassium exerts powerful antagonistic action in reducing manganese assimilation by citrus seedlings.

Investigation on the effect of micro-nutrients on yield of phosphorus and potassium was conducted.

MATERIAL AND METHODS

The experiment was conducted on the Balwant Vidhyapeeth Agricultural Farm Bichpuri, Agra. There were nine treatments comprising of (i) control, (ii) NPK, (iii) NPK+Mn, (iv) NPK+Zn, (v) NPK+Cu, (vi)NPK+B, (vii) NPK+Mo, (viii) NPK+combination, (ix) NPK+spartin. Treatments were replicated twice in a randomized design with a plot size 32′ x 18′. Analyses of composite soil sample of field of experimentation is summarized in the Table I.

TABLE 1. *Mechanical and Chemical Analyses*

Mechanical Analyses		*Chemical Analyses*	
Sand	60.1%	Total P_2O_5	0.024%
Silt	18.7%	Total K	0.712%
Clay	13.7%	Organic matter	0.496%
		pH	8.2%
		Total manganese	100 PPM
		Total copper	62.5 PPM
		Available Boron (in saturation extract)	0.65 PPM
		Available Molybdinum	0.2 PPM

Application of Nutrients:

After preparation of seed bed a basal dressing of NPK (30:30:30) in the form of ammonium sulphate, superphosphate and potassium chloride was done @ 130 lbs. 188 lbs. and 50 lbs. per acre respectively.

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Spartin was mixed in the soil @ 150kg/acre at the time of sowing. Micro-nutrients were sprayed in two lots at an interval of 15 days (first 40 days and second after 55 days of sowing). Volumes of spray was made 100 gallons of each. Mn, Zn, Cu, B and Mo were sprayed in the form of manganese sulphate, zinc sulphate, copper culphate, borax and sodium molybdate @10 lbs. 10 lbs. 10 lbs. 5 lbs, and .5 lbs. respectively. Concentration was °.5, °.5, °.5, °.25 and °0.25 respectively. Combination treatments was sprayed with 35.5 lbs i.e. total of all the above. These values have been given per acre basis.

Phosphorus:

Samples were digested by wet digestion method and "Vanadate molybdate-yellow method of methods of analyses of soils, plants and water was followed. Rouy photometer (Leitz, U.S.A.) was used for reading colour intensity of different samples. Phosphorus in terms of PPM was calculated by the help of standard curve. Yield data were multiplied with these values to obtain yield of phosphorus.

Potassium:

Digested material was used to determine potassium with the help of "Direct reading flame photometer" (Beckman's). Potassium concentration thus obtained was multiplied with yield figures to obtain yield of potassium per acre.

EXPERIMENTAL FINDINGS

Phosphorus yield by grain and fodder per acre is given in Table II.

TABLE 2. *Phosphorus yield by grain and fodder.*

Treatments	Phosphours yield in gms/acre	
	Grain	Fodder
Control	64.0	554.5
NPK	119.9	817.5
NPK+Mn	454.2	683.2
NPK+Zn	211.4	638.4
NPK+Cu	127.9	695.3
NPK+B	154.1	575.3
NPK+Mo	141.7	743.7
NPK+combination	207.1	656.9
NPK+spartin	159.1	654.3
C.D.	160.7	..

——F test not significant

A perusal of the data shown in table II reveals that yield of phosphorus by grain was increased significantly by NPK+Mn, NPK+Zn and NPK+combination treatments when

compared to control. NPK+Mn was the best and differed significantly with NPK+Zn and NPK+combination treatments. However, variation observed in the yields of fodder phosphorus was insignificant.

Potassium yield by grain and fodder per acre is summarized in table 3.

TABLE 3. *Potassium yield by grain and fodder.*

Treatments	Potassium yield in gms/acre	
	Grain	Fodder
Control	80.6	2680.4
NPK	135.4	4718.2
NPK+Mn	400.1	4728.1
NPK+Zn	257.6	2714.9
NPK+Cu	136.5	3116.0
NPK+B	147.5	2079.9
NPK+Mo	124.2	3132.5
NPK+combination	133.6	2864.8
NPK+spartin	127.1	3000.5
C.D.	..	1450.0

An examination of the data depicted in the Table 3 indicated that there was insignificant variation in the yield of grain potassium. Significant increase of fodder potassium yield was observed in NPK and NPK+Mn treatments.

Total yield of phosphorus and potassium is shown in Table IV.

TABLE 4. *Total yield of phosphorus and potassium per acre.*

Treatments	Phosphorus and potassium in gms/acre	
	Phosphorus	Potassium
Control	618.5	2761.0
NPK	937.4	4853.6
NPK+Mn	1137.4	5128.2
NPK+Zn	849.8	2972.5
NPK+Cu	813.2	3252.5
NPK+B	729.3	2227.4
NPK+Mo	885.4	3256.7
NPK+combination	864.0	2998.4
NPK+spartin	816.4	3127.6
C.D.	298.9	

Critical examination of the data given in Table IV reveals that significant increase of phosphorus yield was observed in NPK treatment when compared to control and in NPK+Mn treatment when compared to control, NPK+Cu, NPK+B, and NPK+spartin treatments. Potassium yield does not differ significantly.

DISCUSSION

Rogers and Wu (1948) observed that zinc application enhances calcium and phosphorus uptake. Similar increased uptake of phosphorus was observed during the present studies also. Zinc application affects the roots and its development (Shrivastava, 1964). This might provide increased surface for the absorption of the nutrients. Manganese is essential for the protein (Leeper, 1941) and carbohydrate metabolism (Mchargue, 1926). The amount of soil Mn present in the field of experimentation was very low (100 PPM). Since phosphorus plays fundamental role in phosphorylation, enhanced metabolism might be associated with increased P assimilation. Since potassium is also essential for photosynthesis and translocation of synthesized material enhanced protein and carbohydrate metabolism might be associated with increased potassium assimilation.

SUMMARY

Nutrition of micro-nutrients affects the assimilation of phosphorus and potassium in plants. From the present study following lines of conclusion may be drawn:—

(i) Increased Phosphorus yield of grain was observed by NPK+Mn, NPK+Zn and NPK+combination treatments. Total phosphorus was increased by NPK+Mn treatment.

(ii) Potassium yield was increased by NPK+Mn treatment.

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A Study of the Effect of Different Levels of Nitrogen, Phosphorus and Potassium on the Growth and Yeild of Paddy [1] Grown Under the soil and Climatic Conditions of Jabalpur Farm

S. D. Choubey, S. P. Khurchania, N. S. Patil and R. R. Verma[2]

Nitrogen, phosphorus and potassium are the most important elements which the rice crop requires in large quantities. Ghose *et al* (1956) reported that a crop yielding about 3360 kg. of grain and 3920 kg. of straw per hectare removes on an average 44.8 kg. nitrogen, 33.6 kg. P_2O_5 and 87.5 kg potassium from an hectare of soil. Hither to sufficient attention has been paid to the replenishment of these nutrients in raising field crops, but the importance of potash has not been quite realized. The view that paddy does not respond to potash manuring has been held till recently. That this view is untenable has been amply demonstrated by Mukerjee (1955) in his experiments in Bihar on cultivators' fields. Recent trials conducted in several States in India have also clearly demonstrated the necessity for potash manuring of paddy. Besides this, the application of single element, nitrogen or phosphorus, is usually found to be beneficial only within narrow limits. This is expected because such a single addition, if applied in large quantities, is likely to upset the balance of fertilizer materials in the soil. The amount of any one element, which the plant can absorb, depends on this balances. At many places, it has been found that in areas where phosphate by itself has a little effect on yield, a combination of nitrogen and phosphorus may be markedly superior to nitrogen alone. Sethi *et al* 1940; Dave (1946); I.C.A.R. Report 1959. When nitrogen and phosphorus are made good, the reserves of potassium are bound to get depleted. In such cases, addition of potassium to nitrogen or phosphorus or both is advantageous. (Desai *et al* (1957); Raheja 1958).

MATERIAL AND METHODS

The experiment reported here was conducted at the Adhartal Farm of the Agriculture College, Jabalpur, during the *Kharif* seasons of 1962, 1963 and 1964. Soil of the area can be classified as "Sandy loam" which is locally known as "Sehra." It is well drained, light in nature and is of average fertility. Experimental site was changed in the second year of the experiment. Chemical and Mechanical composition of the soil of the two sites is given in the following Table.

Table 1. *Chemical and Mechanical composition of the soil*

	Sand Percent	Silt Percent	Clay Percent	Available nitrogen Kg/ha.	Available P_2O_5 Kg/ha.	Available Potassium	Organic matter Percent
Site One	62	29	8	125	31	250	2.96
Site Two	54	25	19	120	12	250	1.12

1. Contribution from the Agriculture College, Jabalpur.
2. Professor of Agronomy and post-graduate Students.

These soils were chemically analysed using the following methods. Available nitrogen: Dr. Subbiah's method; available phosphorus: Olsen's method; available potassium Flame photo meter method. Mechanical analysis of the soil was done by International pipette method.

It is apparent that the nitrogen content is very low, the phosphorus content low to medium and the potassium content medium to high. The average pH of the soil was 7.2 and the soluble salts were normal.

The climate of the area is typically semiarid and sub-tropical. Winters are very cold and summers are hot and dry. The average annual rainfall is 1397 m.m. and is mostly received in between June and September and only a little (130 to 190 m.m.) in between October and May. The following table gives rain fall of the three seasons during which the experiments were carried out.

TABLE 2. *Monthly rain fall (in m.m.) and number of rainy days during the cropping seasons*

	1962		1963		1964	
	Rainfall	No. of rainy days	Rainfall	No. of rainy days	Rainfall	No. of rainy days
June	40.0	9	164	10	64	6
July	248.0	23	230	22	445	17
August	350.0	26	380	23	319	18
September	152.0	16	250	15	167	11
October	50.0	1	10	1	4	1
November	..	..	10	1	..	..
Total	840.0	75	1044	72	999	53

The year 1962 was comparatively dry though number of rainy days were well distributed. In 1963 and 1964 rainfall was normal during rainy seasons, excepting that in the later year rainy days were comparatively few.

The experiment was laid out in 3^3 confounding design (complete) with two replications, each comprising 3 sub-blocks of similar dimensions. There were nine plots of different treatment combinations which were allocated in each sub-block according to Yates (1935). The treatments consisted of three levels of N, three levels of P_20_5 and three levels of K_{20}, each at O, 22.4 and 44.8 kg/hac. applied as ammonium sulphate, superphosphate and muriate of potash respectively.

Variety R_{10} (Chhatri), which is of medium duration maturing in 144 days, was selected for sowing each year. Irrigations were given as and when required.

RESULTS AND DISCUSSION

Grain Yield:

Effect of Nitrogen levels on grain yield:

The means of grain yield for different levels of nitrogen are given in the following table.

TABLE 3. *Mean Grain Yield (kg/ha) as affected by different levels of nitrogen*

Treatments	1962	1963	1964
N_0 (O kg/ha)	1020	2239	2467
N_1 (22.4 Kg/ha)	1169	3077	3070
N_2 (44.8 kg/ha)	1241	3522	3402
Average			
'F' test	Sig at 1%	Sig at 1%	Sig at 1%
S. Em.	±24	±91	±41
C.D. at 5%	71	254	120
C.D. at 1%	95	343	161

In all the three years, nitrogen application showed profound effect on grain yield. N_1 and N_2 levels significantly increased the grain yield over no nitrogen. The per cent increase in grain yield due to 22.4 kg/ha level over no nitrogen was very large, that is, 16 to 32 per cent, while the increase with 44.8 kg/ha. level over no nitrogen ranged from 23 to 57. Thus rate of response declined with higher level though the per cent increase is quite high to adopt it for increased production. Since the soil was initially poor in nitrogen content (Table 1), the high response to 22.4 kg/ha. and 44.8 kg/ha. is expected one. Such high increases were also obtained by Mahapatra and Sahu (1963), Islam (1961) and Vachhani and Rao (1956).

Effect of different levels of P_2O_5 on grain yield

The following table presents the average grain yield in kg/ha as influenced by different levels of P_2O_5.

TABLE 4. *Mean grain yield (kg/ha) as affected by different levels of P_2O_5*

Treatments	1962	1963	1964
P_0 (O kg/ha)	1078	2802	2722
P_1 (22.4 kg/ha)	1140	2899	3048
P_2 (44.8 kg/ha)	1198	3137	3162
"F" test	Sig at 1%	Sig at 5%	Sig at 1%
S. Em.	±24	±91	±41
C.D. at 5%	71	254	120
C.D. at 1%	95	..	161

Application of P_2O_5 was found to be beneficial in increasing grain yield by 4 to 15 per cent but the magnitude of increase was less as compared to the increases due to application of nitrogen. This clearly indicates that nitrogen is a greater limiting factor than P_2O_5 under the soil conditions at Adhartal Farm. Secondly, out of two doses, only the higher one (44.8 kg/ha) could bring about significant difference in yield over no phosphorus treatment excepting in the third year when P_1 was significantly superior to P_0. Difference in yield due to P_1 and P_0 was never significant. Thus, it seems that lower level of phosphorus was ineffective, perhaps because the soil phosphorus was enough to meet the requirement. It is only when the dose of added P_2O_5 was enhanced, significant difference become discernible over no phosphorus. Similar results were obtained by Pawar *et al* (1960), Digar (1960).

Effect of different levels of K_{20}

Average grain yield as affected by different levels of K_{20} are presented in the following table.

TABLE 5. *Average grain yield as affected by different levels of potassium (kg/hac.)*

Treatments	1962	1963	1964
K_0 (O kg/ha.)	1120	2832	2871
K_1 (22.4 kg/ha)	1155	3028	3033
K_2 (44.8 kg/ha)	1133	2979	3035
Average			
"F" test	Not sig.	Not sig.	Sig at 5%
S. Em.	± 25	± 91	± 41
C.D. at 5%			120

In the first two years of experiment application of potassium did not produce any significant differences. However, the differences turned out to be significant in the third year at 5% level. This phenomenon can be attributed to two reasons. Firstly, the experimental error was very small and as such though grain yields in the second year and the third year were practically identical for all the three levels of potassium, the difference between K_0 and high levels reached the level of significance. Secondly, since 44.8 kg/ha nitrogen and phosphorus were used continuously every year in this area (for two years during the experimental period and two years prior to the experiment) in conjunction with same quantity of phosphorus as against 20 kg/ha previously, the stock of soil potassium got exhausted due to increased crop yields. Recent experiments (Mukerjee 1955) also indicate that with increase in the levels of nitrogen and phosphorus, the need for potassium application has been felt in various parts of the country.

Interactions:

No interaction was found to be significant in the first two years of experiment, but in the third year N X P; and N X K interactions showed significant results. This finding again confirms the aforesaid views that in the initial period of heavy fertilization of soil nitrogen and phosphorus applied singly are able to exhibit their influence on crop yield but when in the later years nitrogen, phosphorus and potassium react with one another. Only higher levels of nitrogen gave higher response when combined with higher levels of either phosphorus or potassium.

SUMMARY

Studies on the effect of three levels of nitrogen, phosphorus and potassium (O, 22.4 and 44.8 kg/ha. each) on the growth and yield of paddy were made in 1962, 1963 and 1964 Kharif seasons at the Adhartal Farm, Jabalpur. The soil of the area is light and average annual rainfall is 1400 m.m. Findings are summarized below:

(1) 22.4 and 44.8 kg/ha nitrogen levels significantly increased the yield over no nitrogen. The higher level of nitrogen (44.8 kg/ha) was also significantly superior to lower one (22.4 kg/ha) indicating thereby the possibility of increasing the dose further even on light soils.

(2) Phosphorus application was beneficial only when it was applied in higher quantity i.e 44 8 kg/ha.

(3) Application of potassium was found to be of little advantage in the initial stages but with the increased production every year due to continuous use of nitrogen and phosphorus necessity of potassium application was felt.

ACKNOWLEDGMENTS

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"Studies on N, P, and K Deficiencies in Wheat"

HARI SHANKER[1] and R. S. DIXIT[2]

Introduction:

The mineral theory of nutrition of crops enunciated by Liebig as early as 1840 was the starting point to investigate the mineral needs of plants. Scientists have been constantly making efforts to find out suitable methods of determining the nutrient requirements of different crops. Soil and plant analyses, field experimentation and study of deficiency symptoms, etc., are some of the methods used for the purpose. Though the study for deficiency symptoms has several limitations, yet it is possible sometimes to recognize the nutrient need of a particular element, and thus fulfilling the crop needs. Deficiency of major elements, such as, N, P, and K may be commonly reflected on the crops. Hence, a pot culture study was undertaken to study the deficiency symptoms of N, P, and K in wheat with a veiw to note the changes at different stages of growth.

Thatcher (1921) in Cabbage and lettuce, and Garner, *et al* (1934) in tobacco noted that supply of abundant nitrogen increased succulence of the plant. Varner (1933) found increased leaf area in apple by nitrogen fertilization. Crowther (1935) stated that main function of nitrogen fertilization is the initiation of meristematic activity, and that is why it increases the vegetative parts of the plants and is required in early stages of growth. Fisher (1935) observed that in the nitrogen deficiency conditions considerable amount of food material is not transferred from vegetative parts to the seed and as a result the grains are shrivelled. Mulder (1956) reported that potato-tubers from very K deficient plants are rich in tyrosine and showed the blackening of stem end. Hinway (1956) noted that the acceleration of flowering in mustard is due to nitrogen deficiency. Dorokhov (1956) reported that the acute K deficiency not only decreases the photosynthesis, but also results in de-assimilation of Co_2 by green leaves exposed to light. Thomson and Morris (1957) found that both nitrogen and phosphorus deficiencies resulted in increased glutamine and proline contents than normal plants. Mehrotra, *et al* (1965) studied the nutrient-deficiency symptoms in rai.

METHOD AND MATERIAL

Experiment was conducted under controlled conditions in Rabi season in 1963-64 on Students' Instructional Farm, Government Agricultural College in pots of 12″ diameter. These pots were thoroughly cleaned and the drain holes were pugged by glass wool and watch glasses. The treated sand was brought from Shankargarh farm, Allahabad. The sand was thoroughly washed with tap water and finally with distilled water to ensure complete removal of mineral elements. Pots were filled carefully with washed neutral sand.

Sowing was done by putting two seeds per hole in nine hills. After germination thinning was done and nine plants per pot were maintained to grow. The first application of 200 ml.

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Hogland's (1933) nutrient solution was applied after one week of sowing, when all the plants were germinated. The composition of nutrient solutions used for various deficiencies is given in Table I. Subsequent applications of nutrient solution were made at an interval of four days

TABLE No. 1. *Table of Nutrient Solutions Used*

Solution treat-ments	Cal. ni-trate 10%	Pot. ni-trate 10%	Mag. sul-phate 10%	Ferric tar-trate 0 5%	Amm. Di-Hy Phos. 10%	Trace ele-ments	Cal. sul-phate 10%	Pot. Di-Hy Phos. 10%	Pot. sul. 10%	Mag. Nit. 10%	Amm. sul-phate 10%	Remarks
	c c	c c	c c	c c	c c	c.c.	c.c.	c.c.	c.c.	c.c.	c.c.	
No. ..	..	..	19.6	4	..	4	22.16	5.67	17.36	..	..	Each solution was made to 4 littres by adding distilled water and two hundred (200 c.c.) was applied per pot per turn.
Po ..	38.0	24.4	19.6	4	..	4	..	..	..	..	27.2	
KO ..	38.0	..	16.71	4	4.8	4	..	..	..	30.92	..	
Control	38.0	24.4	19.6	4	4.8	4	..	..	..	..	..	

and on intervening days the cultures were watered with 250ml. distilled water. Flushing was also done with distilled water in order to avoid extra accumulation of salts.

Nitrogen was estimated by Kjeldahl method as described by Jackson (1958). Phosphorus was estimated by molybdophosphoric blue colour method as described by Jackson (1958) Potassium was estimated by cobaltinitrite method as described by Piper (1950).

Treatments:—4

Symbol	.. Treatments
No	.. Total Nitrogen deficiency
Po	.. Total Phosphorus deficiency
Ko	.. Total Potassium deficiency
Control	.. Normal nutrient solution containing N, P, and K.

Replications:—2

Total number of pots	.. =8
Number of plants/pots	.. =9
Date of sowing	.. =11th Nov. 1963.
Variety of Wheat sown	.. $=C_{13}$.
Rate of application of nutrient solution	.. =200ml on every fourth day.

TABLE No. 2

Treatments	*Date of Harvest*
No	9.4.64
Po	4.4.64
Ko	7.3.64*
Control	9.4.64

*Under Ko treatment the plants died off earlier and were harvested on 7.3.64,

TABLE 3. *Visual Observations.*

Days after sowing	Treatments			
	No	Po	Ko	Control
21	Leaves turning yellowish.	Normal	Normal	Normal
42	Whole plant developed pale green burning started from tips. Yellowing and burning proceeded towards sheath along with midrib.	Purpling of leaves Burning of leaf tips.	Normal	Normal
63	Lower most leaves fired, firing started from tips. Two lower leaves died. Transparency in leaves and stunted growth.	Burning started from tips and proceeded along the margin. Blotching of lamina, purpling of leaves lower leaves dying off, stunted growth.	Upper leaves normal, burning of lower leaves started from tips. Yellowing followed by burning started from tips and proceeded downwards covering whole leaf blade. Stunted growth.	Dark green, colour, vigorous growth.
84	Plants lean and thin, slender, leaves yellow, transparent, lower leaves dying. Erect stem stunted growth.	Erect but thin stem, lower leaves burnt down, smaller size of leaves. No tillering, stunted growth.	Leaves yellow. Weak stem, tend to fall down. Rest as above after 63 days.	Normal, erect profuse tillering.
105	days As above. ear-emergence started.	As above, no ear emergence	Almost all the plants died off	growing normal, ear emergence started.
126	Plants matured ..	Plants dried, but did not fall down like KO treatment	———	Plants matured.

TABLE 4. *Average shoot height (in cms.) per plant at different stages of growth*

Days after sowing	Treatments			
	Control	No	Po	Ko
21	2.4	2.1	2.2	2.2
42	2.7	2.5	2.4	2.2
63	6.4	5.8	3.8	5.2
84	14.5	7.6	4.0	8.7
105	20.2	9.4	5.7	..
126	27.4	15.5	..	..

TABLE 5. *Average number of functioning leave per plant*

Days after sowing	TREATMENTS			
	Control	No	Po	Ko
21	3.0	3.0	3.0	3.0
42	3.5	2.8	2.1	3.0
63	3.2	2.8	2.6	2.1
84	3.8	2.9	2.1	2.7
105	2.4	2.2	2.0	..
126	..	..	..	..

TABLE 6. *Average number of tillers per plant*

Days after sowing	TREATMENTS			
	Control	No	Po	Ko
21	..	..	..	..
42	0.3	..	..	0.1
63	1.3	..	..	0.2
84	1.2	0.2	..	0.2
105	..	..	..	..
126	..	..	..	..

TABLE 7. *Post-harvest observations*

Characters	TREATMENTS			
	Control	No	Po	Ko
Ear length (cms.)	4.50	3.50	..	..
No. of grains/ear	6.50	5.40	..	..
Wt. of grains/pot (gms.)	1.05	0.65	..	..
Wt. of Straw/pot (gms.)	2.45	1.86	0.81	0.70

TABLE 8. *Percentage of Nitrogen in Grains and Straw*

% of Nitrogen in	Treatments			
	Control	No	Po	Ko
Grain	2.072	1.035	..	..
Straw	0.465	0.238	0.423	0.421

TABLE 9. *Percentage of Phosphorus in Grain and Straw*

% of Phosphorus in	Treatments			
	Control	No	Po	Ko
Grain	0.418	0.367	..	..
Straw	0.151	0.147	0 087	0.149

TABLE 10. *Percentage of Potassium in Grain and Straw*

% of Potassium in	Treatments			
	Control	No	Po	Ko
Grain	0.963	0.887	..	..
Straw	0.527	0.516	0.503	0.268

DISCUSSION

Data in Table 3 indicate the development of pale yellow colour in the nitrogen deficient treatment. It may be due to the absence of chlorophylle which is not synthesized in the absence of nitrogen. Thus, yellow pigments (viz. Carotene and Xanthophyll) predominate, giving rise to yellow colour. In this case the lower leaves are first affected which may be due to the translocation of nitrogen from lower parts to the upper parts of the plants. The development of purple colour in phosphorus deficient plants was also observed. It may be due to either the accumulation of sugars which give rise to purple pigment, "anthocyanin," or due to the creation of artificial deficiency of nitrates, because nitrates are not assimilated in the absence of phosphate. Similar observation were made by Bear, *et al* (1951). Yellowing and burning of tips were observed in the potash deficient plants, which may be due to the translocation of food material from older leaves to upper ones. Similar observations were recorded by Hoofer and Krantz (1951).

Data in Table 4 reveal the reduction in the shoot height in the absence of N, P, and K; in comparison to control. These were in the order: Control > No. > Ko, > Po. This may be due

to the activities of nitrogen and phosphorus which are responsible for meristematic activities. Similar results were reported by Crowther (1935).

Data in Table 5 and 6 show the number of functioning leaves and average number of tillers per plant respectively. Reduction in the number of leaves and number of tillers per plant were observed as compared with control. Crowther (1935) made similar observations on biometric characters of plants.

Data in Table 7 reveal that the ear length in No treatment was less as compared to the control, whereas in Po and Ko treatments there were no ear emergence. Similar observations were recorded in the case of number of grains per ear and weight of grains obtained per pot in different treatments: The weight of the grains obtained in No treatment is less than that of control. It may be due to the shrivelling of seeds as reported by Fisher (1935). The weights of straw obtained under different treatments were in the order as given below:—

Control>No>Po>Ko

Data in Table 8 show that the nitrogen percentages were less in all the treatments in comparison to control. Data in tables 9 and 10 further show that the percentages of P and K in grain and straw were less in all the treatments in contrast with control.

CONCLUSION

Visual observations give specific indications of the deficiency caused by the particula element. N deficiency symptoms are apparent as early as three weeks after sowing, while symptoms caused by P deficiency are visible between three to six weeks after sowing. Potassium deficiency symptoms could be observed at later stages of growth. It may be concluded that N and P are needed in the early stages of plant growth.

Though all macro-nutrients are essential for proper growth of plant, yet P and K seem to be more important factor for grain formation as there was no ear emergence in P and K deficient plants.

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Relative Efficacy of Soil and Spray Application of N and P Nutrients of Jowar*

V. N. Bodade and T. K. Madankar**

The foliar feeding of plants with major nutrients singly or in combinations or with minor elements, insecticides, fungicides or herbicides is of recent origin. Results obtained by various workers show that foliar sprays are definitely helpful as a method of improving crop yield. Most of the nutrients retained by the leaves after spraying are absorbed, often within a few days. Inside the plant it functions in a similar manner to the nutrient that is absorbed by the roots and assimilated within the plant (Egorov, 1957 and Thorne, 1955).

The object of the work reported in this paper was to evaluate the relative effectiveness of fertilizers given through soil and foliage. The results obtained at the Regional Research, Centre, PIRRCOM, Amravati are reported in this paper.

MATERIAL AND METHODS

The experiment was conducted in Kharif season of 1961 and repeated for a period of three years. It was laid out in a simple randomized block design with four replications. The plot size consisted of 8.06 X 4.96 metres. The treatments included were:

Soil application of nutrients, kgs/hectare.

Control, 11.25N, 22.50N+11.25 P_2O_5, 33.75N+25.50 P_2O_5.

Foliar application in two doses in kgs/hectare.

5.63N, 11.25N+5.63 P_2O_5, 16.88N+11.25 P_2O_5, 22.50N+16.88 P_2O_5. N and P_2O_5 nutrients were given through urea and triple superphosphate. The solution of these nutrients was prepared separately at 3 per cent concentration and were mixed together for spray with Teepol B-300 at 0.2 per cent concentration.

RESULTS

Grain yield of jowar: The grain yield is given in Table 1.

Statistical analysis of the grain yield of jowar indicated that there is no effect of different treatments on the yield except year 1961-62. N and P application in general irrespective of its dose and mode of application considerably increased the yield of grain. During 1962-63 season, control treatment behaved distinctly superior than most of the treatments, mainly due to the effect of increase in the plant numbers at harvest. However, overall effect of N and P nutrients was superior to control treatment. Manuring at higher doses level either through soil or foliage gave the highest yield, where as, at lower level, there was considerable reduction in the grain yield. The mean effect of 22.50 N or 33.75N with 11.25 P_2O_5 and 22.50 P_2O_5 (soil) and 16-88N or 22.50 N with 11.25 P_2O_5 and 16.88 P_2O_2 (foliage) on the yield of grain were comparable. It has also been noted that manuring through soil at higher dose level were as good as to its 50% level given through foliage sprays.

*Paper read at the IVth All India Millet Research Workers Conference held in April, 1965', at Hydrabad.

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TABLE 1. *Grain (kg./hectare) as affected by different treatments*

Treatment nutrients in kg./hect.	1961-62	1962-63	1963-64	Mean (3 years)
Control	592	1776	1011	1127
Soil application				
11.25 N	997	1748	1271	1338
22.50 N+11.25 P_2O_5	1284	1569	1719	1524
33.75 N+22.50 N P_2O_5	1809	1331	1648	1596
Foliar application				
5.63 N	843	1734	1567	1382
11.25 N+5.63 P_2O_5	1038	1653	1569	1420
16.88 N+11.25 P_2O_5	1106	1795	1863	1588
22.50 N+16.88 P_2O_5	1383	1748	1339	1490
S. Em.	±194	±199	±189	±110
C.D. at 5 per cent.	563	N.S.	N.S.	N.S.

Fodder:

TABLE 2. *Fodder (kg/hectare) as affected by different treatments*

Treatments Nutrients in kg./hec.	1961-62	1962-63	1963-64	Mean (3 years)
Control	3919	4771	3472	4054
Soil application				
11.25 N	4234	5337	4127	4566
22.50 N+11.25 P_2O_5	5900	5678	5633	5737
33.75 N+22.50 P_2O_5	7087	5832	5437	6119
Foliar application				
5.63 N	5316	4449	5502	5089
11.25 N+5.63 P_2O_5	4564	4664	5240	4823
16.88 N+11.25 P_2O_5	6817	5185	7533	6512
22.50 N+16.88 P_2O_5	6167	4514	5109	5264
S. Em.	±1260	±836	±679	±320
C.D. at 5 per cent.	N.S.	N.S.	1999	930

The perusal of the data reveals that N and P nutrients given either through soil or through foliage give higher yield of fodder than control. However, the differences were significant only in 1963-64 and mean yield only 33.75N+22.50 P_2O_5 (soil application) and 16.88N 11.25 P_2O_5 (foliage application) were observed to be the best treatment in almost all the years and average yield of three years in increasing the fodder per hectare. This also clearly shows that even at 50 per cent reduction of nutrients given through foliage, the response in fodder yield is clearly noted when compared to soil application.

Economics:

TABLE 3. *Economics of different treatments*

Figures are in Rs./hectare

Treatments	Grain	Fodder	Cost of Manures	Cost of Manuring and spraying	Total expenditure	Total profit	Net over control
Control ..	597	203	..	..	..	..	800
Soil application							
11.25 N ..	709	228	20	11	31	906	106
22.50 N+11.25 P_2O_5	808	287	55	11	66	1,029	229
33.75 N+22.50 P_2O_5	846	306	90	11	101	1,051	251
Foliar application							
5.63 N	732	254	10	25	35	951	151
11.25 N+5.63 P_2O_5	753	241	27	25	52	942	142
16.88 N+11.25 P_2O_5	842	326	45	31	76	1,092	292
22.50 N+16.88 P_2O_5	790	263	63	38	101	952	152

Grain @ Rs. 53/- 100 Kgs. Fodder @ Rs. 5/- 100 kgs.

Every manurial treatment of N and P given either through soil or foliage proved to be profitable. Highest profit has been realized due to 16.88N+11.25 P_2O_5 (foliar) and 33.75N.+ 22.50 P_2O_5 (soil). The second best treatment was 22.50N+11.25 P_2O_5 (soil).

SUMMARY

The efficiency of foliar application of N and P nutrients as compared to simultaneous application of the same to the soil has been investigated on Jowar at the Regional Research Centre, PIRRCOM, Amravati, in Kharif season of 1961-62, 1963-64.

(1) Application of various doses of N and P_2O_5 increased the yield of Jowar. The responses were high at higher level given either through soil or through foliage.

(2) The dose of 33.75N+22.50 P_2O_5 (soil) and 16.38N+11.25 P_2O_5 (foliage) were found effective in increasing both grain and fodder per hectare. The yields obtained in these two treatments were comparable.

(3) From the point of view of economic return application of 16.88N+11.25 P_2O_5 (foliage) and 33.75N+22.50 P_2O_5 (soil) gave the highest net gain over the control.

(4) This investigation indicates that if all the N and P requirement of jowar crop cannot be applied to soil for some reasons, there is a possibility of increasing the jowar yield by supplementary spray application.

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Technical News

FISH FLOUR MANUFACTURE*

The Central Government is considering a proposal to set up plants in the coastal regions for the manufacture of odourless fish flour which could be used as an item of food. An expert in the line, Mr. B. P. Sahasrabudhe, has submitted a scheme. The Government has accepted the scheme in principle and has asked for detailed information.

Mr. Sahasrabudhe is reported to have exhibited to newsmen in Poona biscuits, flakes, and chutney made from such fish flour. Fish being rich in protein it could be an ideal substitute for milk, according to Mr. Sahasrabudhe.

According to him a fish processing factory yielding daily about 10 tonnes of fish flour products like fish flakes, biscuits etc., can be erected in three months. No foreign aid would be needed. The total cost for erecting such a factory would be Rs. 33 lakhs. The annual sales could be up to Rs. 7.5 crores.

Employment could be found in such a factory for a thousand persons. The bones of fish could be used for producing fish glue.

A total of 100 tonnes of fresh fish should have to be processed per day to yield 10 tonnes of fish flour. The price is indicated at Rs. 5 per kilogram.

JAPANESE MINT, A NEW CASH CROP*

Japanese mint is likely to become an important cash crop in India. It is the source of menthol and mint oil—the costliest oil being imported into the country today. The oil is used in medicinal preparations, tooth pastes, mouth washes and confectionaries.

Japanese mint is a small sweet-smelling plant which grows all the year round. It has shallow roots, light blue flowers and small flat leaves with oil glands on their surfaces.

It can be grown in areas having a high average mean temperature, ample sunshine and a rainfall of 254 to 266 cm (100 to 105 inches). The soil must be fine, rich in humus and minerals, ferrite and well-cultivated. Well-drained sandy loams and red or lateritic soils have been found suitable.

The distillation and separation of mint oil is similar to that of lemongrass oil. The spent materials is an excellent organic manure and can also be used as fuel or cattle feed.

Japanese mint has already grown profitably in Kerala. In experiments conducted at the Lemongrass Research Station, Odakkali (Kerala), a profit of Rs. 1,856 was obtained from the oil extract from a one-hectare crop.

The Planters Chronicle

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*Taken from "*Arya Swapatra*" Farmers, Own Bulletin, Volume II No. XIII, Feb. 12, 1966.

GERMAN FERTILIZERS FOR MANDI FARM

A six-ton earth drilling machine, a tractor and 22,000 bags of chemical fertilizers have been received from West Germany for the Indo-German agricultural project in Mandi district of Himachal Pradesh.

Under the Mandi project, which was based on an agreement between the Government of India and Federal Government, West Germany is providing an advisory service as well as modern agricultural implements.

Under the advisory service a team of seven German agricultural experts along with German Peace Service volunteers are working in co-operation with 300 Indian experts for the last three years.

Formerly where on an average 14 tons of chemical fertilizers were used, at present 1,400 tons are being used. Production has increased three times after the German experts have made demonstrations over 750 farms for the use of fertilizers.

CO-OPERATIVE FERTILIZER FACTORY*

The American Co-operative Union has made a proposal for setting up a fertilizer factory in the co-operative sector. It will meet the necessary foreign exchange requirements. The proposal is being considered by the Government of India.

V.A.M. COMPOST*

The letters V.A.M. stand for "Vuilafvoermaatschappij" the Dutch equivalent for Refuse Disposal Company. This company was formed in 1931 for converting town refuse from The Hague and Zandvoort into compost, which at the time was to be used mainly for the reclaimed peat soils in the province of Drenthe.

The V.A.M., which is sited at Wijster (Drenthe), is the largest composting plant in the world, and has, since its founding, produced 2 million tons of compost.

From 1931 to 1951 the V.A.M. was the only plant that processed city refuse into compost. Since 1951 several other composting plants, using different processing methods, have come into being. At present the Netherlands has 15 mechanized composting plants with a total production of about 200,000 tons of compost per annum.

In the course of the years, however, a change in the marketing design occurred and horticulture and recreation (sports fields, public parks, private gardens, etc.) are coming increasingly to the fore as important buyers.

Instead of the coarse quality these buyers demand finer kinds of compost, a demand which formerly could not be met by the V.A.M. in sufficient quantities.

As a result of the new processing installations coming into operation this is a thing of the past and today the V.A.M. is able to supply any quality in any quantity at any given moment.

Compost can now be had in six qualities: agricultural and horticultural compost, extra fine or super compost, peat compost, heating compost and compost for ornamental plants.

*Taken from "*Arya Swapatra*" Farmers, Own Bulletin, Volume II No. XIII, Feb. 12, 1966.

The following gives some percentages of the use of city refuse compost in the Netherlands. Horticulture tops the list with 50% (fruit 8%, flowerbulbs 16%, vegetables 14%, heating compost 12%). Next comes recreation with 30% arable farming with 14% grassland farming with 3% and 3% for mixing with farmyard manure.

FISHERY RESOURCES*

The Indian Ocean Expedition has estimated that only 1 to 8 per cent of the fish available along the Eastern and Western Coast of India is being caught at present. In other words, the supplies of sea fish along the coasts of India could be increased 20 times if this resource is exploited fully, in the way in which it is exploited by the people of Japan, Great Britain or other countries of Western Europe. The supplies could be increased even more by adopting presently known methods of fish culture. The reservoirs in our river valley projects offer scope for (fresh-water) fisheries of great magnitude. What can be done in this direction is demonstrated by the experience on the Tungabhadra Dam where supplies of fish (for fish culture) have increased within a few years from 700 pounds to 300,000 pounds. Some of the slower moving rivers offer good possibilities of the slower for culture of algae which are rich in protein food.

USE OF WASTE MATERIAL

About 8.4 lakh tonnes of basic slag are produced annually from the Indian Steel plants which contain 45-48 per cent lime and .25 per cent phosphates. This waste material, if finely powdered, will be a valuable ingredient for liming acid soils which form about one-tenth of the cultivable area. The difficulty of making this slag available in finely ground form can be solved by installing powdering plants near our steel plants.

SCIENCE AND AGRICULTURES

HEBREW UNIVERSITY RESEARCH PROVES HEAT EFFECT ON PINE GERMINATION

A research project carried out by a Hebrew University scientist and financed by the U.S. Forest Service in Washington has cast new light on a well-known foresters' problem. Forest rangers throughout the world dread the destructive power of fire; yet fires among the pine forests, despite the great damage they do, have one beneficial effect; it is well known that they are followed by bursts of pine seedlings.

One hypothesis put forward to explain this emergence is that it is due to the release of seeds from their cones after the fire. But Dr. Adiva Shomer-Ilan, of the Hebrew University, has come to the conclusion, after conducting experiments on pine seeds, that dehydration or the drying of the pine seeds causes germination, notwithstanding the negative effect of the fire's heat.

Working on pines from Israeli and Turkish forests, Dr. Shomer-Ilan compared the results of heating the seeds to temperature ranging 50—100 degrees centigrade with those obtained by dehydrating them in a vacuum oven for various periods of time. She found that heat had a negative effect on the onset of the time of germination and the viability of the seed, while

*Taken from "*Arya Swapatra*" Farmer' Own Bulletin-Volume II No. XIII, Feb. 12, 1966.

dehydration, involving a considerable loss of water in the seed, had a marked beneficial effect on germination, increasing the number of seeds which germinated and accelerating the process.

When she dehydrated seeds in the laboratory by raising the temperature up to 70 degrees centigrade, the effect was beneficial. But the position changed when the temperature was raised above that level, resulting in heat damage, which negated the effects of the dehydration. The beneficial effects of dehydration, which more than offset the effects of heat, may explain the apparent anomaly of forest fires leading to the re-seeding of burnt-out areas.—260.2, March 24, 1966.

AGRICULTURE

ISRAEL'S CLOUD SEEDING EXPERIMENTS PRODUCE SIGNIFICANT RESULTS

Israel's experiments in the artificial stimulation of rain by cloud seeding have produced significant results. Tests have been in progress for 5½ years. The project involves two experimental areas which have been seeded with silver iodide crystals in keeping with a statistical design. The seeding is done by aircraft flying at cloud base level at some distance upwind from the area to be seeded.

In evaluating the results, data from the "buffer Zone" between the two experimental areas and other meteorological stations not affected by the seeding are also used. These and other features of the project considerably reduce the length of the experimentation period necessary for reaching a decision about the results at a statistically satisfactory level.

During the first 4½ years, for which evaluation of the results is complete, an average increase of 15% in rainfall is indicated for days of seeding. The odds are 20 to 1 against this increase being merely accidental. When only the central zones of the experimental areas are examined, the apparent increase in rainfall is even greater and the statistical significance of this increase is very high. The cost of the indicated rainfall increase is extremely low.

The project is financed by the Ministry of Agriculture and is supervised by committees representing the Hebrew University, the Meteorological Service, the Mekorot Water Co. and its subsidiary, Electrical and Mechanical Services Ltd., Water Planning for Israel Inc., and the Department of Civil Aviation. Physical-meteorological research, statistical design and evaluation of the experiment and the overall scientific direction of the project is in the hands of Hebrew University scientists, while the project on the whole is conducted by Electrical and Mechanical Services Ltd.

The results were reported in December 1965 at an International Scientific Conference on weather modification held at Barkeley, Calif.—260.2, April 1, 1966.

BRITISH MOBILE NUTRITION UNITS FOR INDIA

LONDON—The first of nine British-built mobile nutritional units for India, each of which can carry more than £ 300 (Rs. 4,000) worth of equipment ranging from a refrigerator

Consulate of Israel, 50 Pedder Road, Cumballa Hill, Bombay 26.

to a can opener, was shown in London on March 9, 1966, at the Balham headquarters of the Civil Service Clerical Association.

The units, built on the long wheel-base Land Rover chassis and carrying bodies specially constructed by the makers of the "Dromobile," were bought at a total cost of £ 23,000 (Rs. 3.07 lakhs) by supporters of the Save the Children Fund and Freedom-from-Hunger campaign projects.

The 150,000 members of the Civil Service Clerical Association joined in the campaign to raise the purchase price of the units with civic Freedom-from-Hunger committees as far apart as Southampton and York. Senior students of Farringtons Girls' School, Chislehurst, Kent, raised £ 3,000 (Rs. 40,000) by publishing *Pot Luck*, a book of recipes which they collected, from Embassies, cinema and stage celebrities and friends in Britain and overseas.

RURAL DEVELOPMENT AND NEW TOWNS IN BRITAIN IMPRESS INDIAN M.P.s

Month's Tour by Parliamentarians

The development of rural industries, the building of New Towns, and advances in agricultural equipment have impressed four Indian M.P.s currently paying a month's visit to Britain at the invitation of the Commonwealth Relations Office.

The visitors are Mr. K. S. Ramaswamy, member of the Rajya Sabha, Dr. Sarojini Mahishi (Lok Sabha), Mr. Chandra Shekhar (Rajya Sabha), and Mr. S. S. Deshmukh (Lok Sabha).

In the past three weeks the parliamentarians have visited textile and steel mills in the English Midlands, toured rural communities in the North of Scotland, and had discussions with local-government officials in a number of cities.

Tour Impressions

Commenting on the tour, Mr. Ramaswamy said in London on (July 8, 1965) that there had been a great deal to interest him and his colleagues on this "fact-finding visit."

Mr. Ramaswamy said that as he represented a rural area—in Madras State—he had been interested in seeing new agricultural equipment in Britain and also the way in which crofts helped to support small communities living in the Scottish Highlands.

Agricultural Development

"Two implements I have seen which I thought might be beneficial to agriculture in India were a new type of rotor which loosens up the soil, and a small, extremely manoeuvrable plough," he said.

"Agricultural development is a field in which India is active and interested in, and we were all very impressed with our visit to Scotland, where we saw how the problem of making rural industries economically successful had been solved."

Mr. Ramaswamy said that they saw another aspect of rural development when they visited a fish processing plant in Stornoway, where local catches were canned without any delay and with no storage costs. "Our fishing industry could be developed much more—and this has given me some interesting thoughts about it."

Prefabricated Houses

While on a visit to Fort William, in Scotland, the M.P.s saw a number of prefabricated houses. "They have the advantages of being cheap, can be produced in quantity by factories, and can be erected quickly," said Mr. Ramaswamy. "I think that these factory-produced houses would be the answer to India's housing problem, and if we could set up the factories to produce them it would be ideal."

The parliamentarians also visited Cumbernauld New Town, near Glasgow. The main purpose of the town is to relieve congestion in Glasgow and provide homes for 70,000 people, the majority travelling to and from the city every day.

Before their tour ended on Wednesday (July 14, 1965), the M.P.s visited the BBC Television Centre and had talks with Mrs. Barbara Castle, Minister of Overseas Development. BF745.

BREAKTHROUGH IN LOCUST CONTROL POSSIBLE

Encouraging Results Obtained

By British Scientists

LONDON, August 9—The possibility of a breakthrough in locust control as a result of a British discovery is referred to in an article in the latest issue of *Tropical Science*, the quarterly journal of the Tropical Products Institute, London.

The new methods of exterminating locusts may follow research by British scientists on how the insects develop their eggs.

In experiments with North African locusts, two members of the Department of Zoology of the University of Sheffield, in northern England, Dr. K. C. Highnam and Dr. L. Hill, claim to have proved that egg development is controlled by two endocrine glands in the locust's head.

Limiting Reproduction

By killing one of these glands with chemicals it would be possible to stop the locusts breeding. Since their fast reproduction rate is one of the factors that makes locusts particularly dangerous, this method of limitation could eventually prove to be more effective than the poison sprays now used to kill them.

One of the two glands controls the manufacture of yolk material for the eggs. The other, known as the *corpus allatum*, transfers the materials from the blood into the eggs, "switching" on and off as needed. If the *corpus allatum* could be neutralized by a chemical agent, this would effectively prevent breeding.

Next Step

The next step is for the chemist to undertake the task of finding a suitable agent, and the university department is passing results to the Anti-Locust Research Centre in London. Dr. P. Haskell, Director of the centre, which co-ordinates anti-locust research throughout the world, has said that the Sheffield team had started to unravel a complex and potentially valuable subject of study. The centre is giving financial support to locust research work at the university department, which claims to be one of the leading centres of endocrionology in Europe.—B15, B895.

WAR AGAINST CATTLE TICKS

Commonwealth Experts Visit British Research Station

By Roy Herbert

Agricultural experts from Commonwealth countries who were in Britain recently for the Commonwealth Agricultural Conference took time off to visit the laboratories of Cooper, McDougal & Robertson Ltd. at Berkhamstead, near London, a firm which has been engaged in fighting the menace of ticks since 1895. The Cooper Research Station is the most comprehensive of its kind and strains of ticks are imported from all over the world for breeding and control experiments.

Cattle ticks are among the most implaccable enemies of agriculture. They cause world food losses of at least £100 million and are by far the largest pest of livestock production in the world. They are found in Africa, Australia, North and South America, and large parts of Asia.

The ticks feed on the blood of animals, mostly cattle, but including others. Their eggs are laid on the ground, where the larvae hatch out and attach themselves to cattle brushing against the leaves of grass. The later stages of development may continue on one host or on several, but the female tick finally engorges itself with blood before falling to the ground and laying eggs to start a new cycle. She may lay as many as 20,000 eggs.

The progeny of one tick is capable of removing one-and-a-half litres of blood from its host and a single tick could produce millions of offspring in three generations. Not only do ticks cause loss of condition in cattle—they are also carriers of diseases that can be fatal. In Africa, for example, one species, the brown ear tick, is the chief agent of Africa's most notorious cattle disease, East Coast fever.

Difficult Task

The work of control is complicated because ticks, like other types of insect, are beginning to show resistance even to the latest forms of insecticides. At the Research Centre the search for new ones that are effective and yet harmless to animals and man goes on constantly. They are first tried with larvae, promising ones are then tested for their killing power on engorged females and, if successful, are then tried in spray tests with infested animals. After this, the Research Centre carries out field trials in Africa, South America and Australia. Only then are the insecticides approved for use on cattle.

Eradicating ticks is an almost impossible task, but they can be kept under control with meticulous and systematic treatment of cattle. The representatives were shown several methods by which this can be done cheaply and easily. They saw cattle driven through a "spray race" developed by the research centre for treating large herds which completely drenches the animals in a tick-killing wash and several hand-operated equipments by which small numbers can be kept tick-free—BF817.

MECHANICAL TEA CULTIVATION

Soviet agricultural machine designers worked hard to ease the labour of the tea-growers. Machines were used to prepare the soil for inter-row cultivation and fertilization. Tea plucking, the most arduous and tedious operation, still had to be mechanized.

Much time, money and effort were required, to design a machine which could cope up with this job as efficiently as man. With its mechanical fingers it delicately feels the tea flushes, plucking the youngest and tenderest leaves, which go to make the choicest grades of tea. The machine does the work of tens of pluckers, thus making it possible to gather high grade leaves and receive higher profit.

"He lives like a Georgian tea grower," the Soviet people say referring to the high living standard of a peasant.

The story of Soviet tea cultivation is a story of the subjugation of nature of man.—Soviet Features—Vol. IV No. 17 January 25, 1965.

PLANT BREEDERS' ASSISTANTS

By A Novosti Press Agency Correspondent

Have you ever seen a thrasher that can be placed on a desk, or a seeding machine the size of a small bicycle? If not, we should like to acquaint you with this unusual family of agricultural machines, often called "midgets," which serve as dependable assistants of plant breeders.

A few words about plant breeding in the Soviet Union. There are more than 4,500 experimental seed breeding and crop testing stations in the country. Hundreds of new varieties of field and garden crops have been developed at these stations, and many of them have become known throughout the world.

The volume of plant-breeding work in the Soviet Union is so tremendous that it is very difficult to do, it without special "midget" machines. Such units are being developed at the All-Union Research Institute of Mechanization of Agriculture.

The small room I entered can hardly be called a ground for testing farm machines. Nevertheless, it is earmarked for this purpose. It was here that I saw a miniature machine with transparent walls, undergoing tests.

Anxious to learn its purpose, I asked Engineer Ella Tsivtsivadze what this machine was used for. "To thrash one ear," she replied.

"Plant breeders at experimental stations of U.S.S.R. have to thrash up to 2,000 ears of different varieties." Much time is needed to do this work by hand, but the new "midget" machine can thrash an ear in only 2—3 seconds. The transparent walls make it easy for those who do the selection to observe the thrashing process. And observation of this work is very essential, because even if one grain were to remain in the thrasher, it would cause the mixing of varieties and the loss of many years of the plant breeders' work.

UNIQUE MACHINES

Next to the thrasher stands a somewhat bigger machine—a unit for cleaning and grading selected seeds of all agricultural crops. The new, so-called vibration method is applied in this unit. It prevents harming of the grain. This is highly important, because high-quality seeds are very expensive.

A number of problems were faced, when this work was first begun in the U.S.S.R. The development of a new variety begins with one ear and ends with strain-testing on 600-square metre plot. In order to mechanize the entire process of this work, 85 different, unique machines are required. Success has been achieved in creating several of them, which are already being utilized at crop testing stations. It is now believed, that it will be possible to complete the all-round mechanization of plant breeding work in the next two years.

NEW SPRINKLING MACHINES

There are about 10 million hectares of irrigated land in the Soviet Union, and the country's machine-building plants naturally supply the irrigators with many sprinklers.

A "battery" consisting of five long-distance sprinklers, the flight of their streams reaching 40 metres, supplies sufficient moisture on a 200-square-metre plot in five minutes. This system for large tracts of irrigated land, alongside with over 30 of the most varied, serial and experimental machines put out in the U.S.S.R., was demonstrated at an exhibition recently. A perfected sprinkler plant attracted special interest among agricultural workers. Its giant 100-metre wing span, equipped with sprayers, lends it the appearance of aeroplanes seen in the early part of this century.

Installed on a tractor, it sprinkles the fields when in motion. It can irrigate a 150-hectare plantation in one season, and is serviced by only one person. Water is fed in this machine through flexible pipes as it moves along the irrigational canal. It may be noted, however, that concrete pipes are steadily replacing open ditches in the U.S.S.R., inasmuch as they reduce water evaporation. Farms which have gone over to the closed-watering system, use an attachment consisting of a hard receiving branch pipe, which feeds the water into the sprayers. For this purpose there is a slit in the upper part of the concrete pipes. The cost of the machine and the tractor is comparatively cheap, and is readily purchased both by collective farms in the Soviet Union, as well as abroad.

Of the experimental models shown at the exhibition, the unit for subtilling irrigation was appreciated most. Sprinkling is carried out by this machine simultaneously with cultivation. Moreover, it can apply both water, as well as any liquid fertilizer in the soil. Its capacity is half a hectare of land per hour. Specialists believe that big prospects are opened to subtilling irrigation, inasmuch as the moisture is supplied directly to the roots of the plants and is preserved for a long time.

During eighteen months of the exhibition, designers and workers of Russia's agricultural machine-building plants exchanged opinions. As a result, several new sprinkler models have been recommended for mass production.—Soviet Features, Vol. III No. 282 December, 10, 1965.

MULTI-PURPOSE TRACTORS

By Semyon Marieve, APN

The Belarus tractor does many a job: it sows and ploughs, when necessary it works like an excavator or bulldozer, as a machine for cutting and loading timber. At present one more job has been added to this long list.

Slopes and cuttings on railways and canals, lawns and boulevards in new residential districts, parks and gardens have to be sodded. Sod-cutting is a most labour-consumming manual job. Designers decided to use the Belarus tractor for mechanizing this work. They supplied the tractor with a device in the form of knives and support skis, thus transforming the tractor into a sod-breaking plough.

HORIZONTAL KNIFE

When the tractor moves along a grass-covered field, the horizontal knife, adjusted in front of the tractor undercuts the sod. The support skis while pressing down the cut layer keeps it from "turning" up. Simultaneously, the skis regulate the depth of the cut—they, so to say, repeat the irregularities of the terrain. The vertical knives cut the sides of the strip. Thus, an endless sod strip continuously moves from under the tractor while it operates in the field.

This strip has to be cut into squares and loaded. This is easily done by the sod-stacking mechanism mounted behind the tractor. A transverse knife, fastened on the frame of the sod stacker, lowered at regular intervals cuts the green strip. Its width is determined by the vertical knife regulated in advance. Fork-like clamps operated by hydraulic cylinders take hold of the cut sod squares and load them into the lorry which follows the tractor.

This machine can cut more than 300 square metres of sod per hour.—Soviet Features, Vol. IV No. 43, February 25, 1966.

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ALLAHABAD, U.P.

Suggestion for Contributors to The Allahabad Farmer

Manuscripts dealing with all aspects of agriculture and rural life, eductional or research, are accepted for publication in *The Allahabad Farmer*. Manuscripts should ordinarily have more than purely local interest. Articles must be original material previously unpublished elsewhere. After review, each manuscript will be accepted for publication upon recommendation of the Managing Committee.

Manuscript. Two copies, one on bond paper, should be furnished for each manuscript. Double space everything—text, title, footnotes, literature cited, captions and tables (except in long tables). This is to provide space for clear marking for the printer. Number all pages consecutively. An additional copy of the manuscript should be retained by the author to ensure against loss.

Use as short a title as practical. Following the title give the author's name(s). It is desirable to divide the manuscript into sections with such headings as Methods and Materials, Results, Discussion, Summary, and Literature Cited. The order of items in the manuscript should be 1. Title and Author; 2. Text; 3. Summary; 4. Acknowledgment; 5. Literature Cited; 6. Tables; 7. Captions for figures; and 8. Figures.

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By Miss Ellen Moline

Home Economics Adviser

The Ford Foundation in India

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A Short Review of the Literature on Tillage and Seedbed Preparation in India

L. G. ULSAKER*

INTRODUCTION

Presently the misuse and under-development of agricultural land is widespread throughout much of India. This poor conservation of land, mankind's most important natural resource, is contributing to the people's low level of living, causing undue hardship and even starvation. Compounding the urgency of improving the agricultural production is the fact that so little is being done to reduce the population explosion.

With the pressure of people on the land exists their inability to acquire sufficient capital to invest in those things which might improve their farming enterprise. It is, therefore, the traditional methods of cultivation that are still of first importance, methods that have changed but little in the past thousand years, that must be largely considered in India. It must also be admitted that it has seldom been possible to offer the Indian cultivator modern implements which are improvements on his own under the conditions in which he has to work. Notable exceptions exist but their number and their ability to increase production enough to meet the demand of food grain is entirely inadequate.

The potential for higher production of food and fiber in India seems very good. For one thing, on an average, yields can hardly be any lower and when the farmers are able to take advantage of all the technological developments in agricultural production and combine them with their natural resources and long growing season, not only will their yields increase but their net profit should——much more so.

Farmer interest in improved seed, implements, fertilizers, plant protection, mechanization, etc. is growing. In some areas very rapidly. When this interest expresses itself it is our responsibility to be prepared to come forth with sound recommendations on these various topics that are based on responsible research and experience.

*Agronomy Department, Allahabad Agricultural Institute, Allahabad.

This paper will primarily deal with tillage and seedbed preparation, actually an interesting field of study.

An amazing amount of disagreement can arise during a discussion on the subject, even among men who have worked the same type of land for the same crop during the same year. Much of the misunderstanding is probably due to the fact that, in the past, most of the research attention was given to the fertility aspects of crop production and the physical requirements of the plant were almost ignored. When farmers began using fertilizers, insecticides, herbicides, etc. many of them obtained high yields despite their cultural practices of tillage rather than because of any contributing factor that they might have derived from them. Therefore a compilation of the research results that have been obtained in India might be of some value.

Higgenbottom (5) reclaimed badly eroded, weed infested land for which farmers wouldn't even pay 30 paise per acre rent in 1912. He did this by ploughing, with a mouldboard plough and a deep tillage tool drawn by six pair of bullocks, during the hot weather when the fields were dry and hard. Thereby eliminating weed competition and preparing the land for crop production. Much of the present day farm and campus of the Allahabad Agricultural Institute was wasteland that has been reclaimed with improved tillage implements and practices. Higgenbottom (5) felt that better farm tools and implements are at the very foundation of improved agriculture of India; that with his present tools and implements the Indian farmer had gone as far as he could go. This was in 1921.

In 1940, Ayyar, V. R., Ayyar, S. S. and Tirumalachari (2) published data signifying that ploughing at five or nine inches depth had no significant effect on cotton yields on heavy soils during the monsoon in Koilpathi; that time of ploughing in stubble after the February—March harvest had no significant effect on yield of the crop planted in September and that comparing yield data from seedbeds prepared by, one, a blade harrow and two, by a soil inverting plough showed no significant difference for cotton and pearl millet but did for sorghum. They also compared ploughing with no ploughing for four years and were surprised that ploughing caused no increase in yield of cotton, pearl millet and sorghum. As a matter of fact no ploughing resulted in a significantly higher yield of cotton one year. Upon comparing the data collected from yields of fields that were ploughed, not ploughed and blade harrowed, they discovered that preparing the land either with blade harrow or plough was no improvement over an undisturned fallow.

Stewart (20) concluded that where the standard of cultivation by country implements was high, the use of improved implements had no significant effect on yield.

Raheja (17) reported that a significantly higher yield was obtained by tractor ploughing the land at ten inches depth as preparatory tillage for *bajra* (pearl millet), than for surface cultivation with harrow or bullock soil inverting plough five or six inches deep followed by country ploughing. The seedbed treatment effects were non-significant in the case of wheat.

Khan (9) observed that tractor cultivation at greater depths (7") was not conducive to bigger yields and tended to pulverise the soil too much but that for reclaiming lands badly infested with weeds it has no parallel.

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After finding the effect of deep ploughing of a sandy loam on the yield of maize to be non-significant, Khan and Mathur (14) switched their tillage experiment to a clay-loam, irrigated soil near Delhi. There they concluded that ploughing deeper than five inches had no significant effect on maize yields, pulverizing the seedbed into a dust-mulch by discing is undesirable and that the effect of soil inversion is not marked on fields with no weed problem.

Khan (12) found the same conclusions when working with wheat on a heavy soil.

On a sandy loam, Khan (13) said that the yield of potato tubers was not affected by a variation in cultivation depth nor by the inversion of the soil.

Of the tillage studies conducted by Khan and Mathur (15), the first significant response to deep ploughing came from pearl millet on a sandy loam soil in Delhi under rainfed conditions in 1961.

More recently Hukkeri and Moolani (7), in their tillage studies in West Bengal, found that different depths of ploughing produced highly significant response in the grain and stover yield of maize.

About the only known experimental study in India of the influence of the mouldboard plough and cultivator on yields was made by Roy (18) who reported non-significant differences among plots prepared by the *deshi* (country) plough and plots prepared by various combinations of improved implements.

In 1954, Shri Ram Krishna Singh (6) of Barkatpur, Uttar Pradesh, raised 64 maunds, 11 seers of wheat per acre. He ploughed 4 times during June, 1953, then planted sannhemp, *Crotalaria juncea*, which, in July, he ploughed in for green manure with 6 maunds of bone meal. Before October the field was ploughed 15 times, 6 maunds of castor cake and 2½ maunds of superphosphate were applied and ploughed in twice. It is assumed these treatments were given per acre. The seed was drilled in rows 7-8 inches apart in October and weed hoeing and earthing up done 2 times, 20 days apart in November. Four irrigations were given before harvesting in April.

Kaul (8) appears to be the first in India to conduct statistical research on the specific effect of cultivation frequency on wheat. In 1956 he reported that nine ploughings as compared to three and six resulted in the highest yield of wheat with no significant difference between nine and twelve ploughings.

Khan (11), found the same results to be true under Delhi conditions and states that it would be poor economics for husbandman not to reduce tillage cost and cheapen production; that under Delhi conditions nine ploughings should be considered optimum.

Ganguly and Relwani's (3) study of the effects of three cultivation treatments for seedbed preparation on the yield of wheat showed no significant difference due to the three treatments, viz., tractor and allied implements, bullock drawn 'Victory' inversion plough-cum-non-inversion Country plough and only Country plough.

Khan (10) wrote that regarding frequency of tillage for maize and wheat, the findings are against dust-mulch preparation of seedbed.

Shah and Patel (19) working on a sandy loam at the Institute of Agriculture, Anand, Bombay, concluded that interculturing of Tobacco and Brinjal had a negative effect, if any, on nicotine contents of tobacco and on the yield, average value in rupees per maund and cash realization in rupees per acre of both crops.

Vaugh and Peter (21) recommended the following rainy season seedbed preparation on a sandy loam in Allahabad.

(*a*) Dry weather ploughing in preparation for the rainy season crop.

(*b*) Cultivation with disk harrow or tine-cultivator at least once between the third and tenth day after the first rain that starts germination of weeds and grasses.

(*c*) Seeding, in line, as early as possible after cultivation.

(*d*) Interculture upto three times.

Anand (1) feels that the best time to plough in the Deccan and Karnatak is at the end of March or beginning of April immediately after the crop has been harvested. He says harrowing should follow after about 3 weeks, four times at monthly intervals in the case of deep soils and twice at monthly intervals in the case of medium and shallow soils.

Panikkar (16), advised bunding and scooping as well as fallowing to conserve moisture under dry farming conditions. He reported the yield of pearl millet after fallow was twice that after guar and gram in the Punjab; gram after pearl millet gave twice that of gram after wheat. Crop mixtures of horse gram and setaria and groundnuts and seteria were best in providing ground cover without too much competition.

In their comparative study of the Gangetic alluvium under cultivation and afforestation, Ghildyal, Shrikhande and Prasad (4) reported that intensive cultivation exerts a profound influence on the soil genesis through the modification of the physical and physico-chemical properties, and tends to reduce the fertility of the soil.

DISCUSSION

From the literature it is evident that the problem of seedbed preparation is a complex of many factors. The predominant factor, which seems almost universal, is the limited amount of research that has been conducted. Much of that which has been done was not coordinated, so that when the results from one practice counterdicted that of the same practice done in another part of the country the causative factors of the difference were not given further study. The lack of long term projects looms as a potential problem if the residual effects of the continuous use of certain tillage tools is ever considered valuable. Data on the necessary soil conditions required by the various crops and the most economical means of mechanically manipulating the soil to provide these conditions is lacking. As the necessity of being articulate increases the usage of terms will have to be standardized. The definitions of seedbed and rootbed is an example. Other factors such as the moisture content, per cent. organic matter, and granular nature of the soil need to be correlated with good tilth of the various agricultural soils and the most economical means of maintaining these factors at the proper level.

I feel that most all of these problems are realized and are being worked on in varying degrees. I'm sure there are others who have run into equally, if not more, important problems related to seedbed preparation and tillage. Now is our opportunity to exchange our ideas, share our results and cooperate where desirable in our common efforts to increase productivity.

CONCLUSION

Evidence as to the possibility of decreasing the expense of seedbed preparation for the various grain and fiber crops on the various soil types of India is inconclusive, but the indications are favourable for a thorough investigation as to the information of economic value that this form of research might provide. Past low yields of the Indian farmer should not be allowed to prejudice the future value of his implements. Actually the traditional wooden plough seems to form a valuable function in that it stirs and opens the top soil without inverting it so the active, fertile soil is kept at the top. It must be remembered that we are striving for sound data upon which to base recommendations for the most economic seedbed preparation methods. Methods that the farmer can put into practice immediately with little or no outlay for additional equipment. We must also be prepared to offer recommendations that apply as increased power through mechanization becomes available.

If a large number of ploughing has a significantly favourable effect on yield we should know why. If it is for weed control or increased availability of plant nutrients then we must study the economic value of the alternatives—herbicides and fertilizers.

The farmers' valuable opinion on why he tills seems to have been somewhat overlooked. In personal conversations with farmers I have heard many of the conventional reasons given in soils text books plus one that is not in the books—" to avoid criticism from the neighbour."

The benefits of minimum tillage have created a widespread revival of interest in the physical requirements of plants during the past 15 years among those connected with agricultural productivity in the U.S.A. This is another area in which we need to clearly understand the terminology. We need to be able to clearly explain and demonstrate to the farmers the value and benefits of doing the least tillage necessary rather than the most tillage possible. Another important tillage consideration is how best to handle crop residues.

A last word on minimum tillage is taken from a presentation at the 1965 Winter meeting of the American Society of Agricultural Engineers.[1] "It is important to recognize that not all soils and climatic conditions are currently condusive to minimum tillage practice. Cultural practices to form beds, control early weed growth, produce optimum soil particle size for seed germination and seedling growth,, as well as many operations for subsequent insect and weed control now require many trips over the field—resulting in increased compactions and reduced infiltration rates."

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Certain Pre-Plant and Pre-Emergence Herbicides for Weed Control in Potatoes*

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Potato requires two to three weeks for emergence and establishment. Weeds emerge and establish earlier and therefore compete with the potato seedlings. In case of severe weed infestation, significant reduction in tuber yield may result. Manual weeding has been the only means of weed control at this stage of the crop since mechanical control is not possible. Several herbicides, such as Pentachlorophenol (PCP), 4, 6-dinitro-o-sec-butylphenol (DNBP) (Rijkslandbouwhogeschool, 1959), 2, 2—dichloropropionic acid (Dalapon) (Nation, 1961), N-(3, 4-dichlorophenyl) N', N'-dimethylurea (Diuron) and N-(4-chlorophenyl)-N', N'-dimethylurea (Monuron) (Kramer and Liederman, 1961), Trichloroacetic acid (TCA) (Rijkslandbouwhogeschool, 1960), and Triazines (Kramer and Liederman, 1961), have been successfully used in other countries. In India, Awasthi *et al* (1960) reported good weed control from pre-emergence application of 2, 4-dichlorophenoxy acetic acid (2, 4-D) resulting in increased yield of potato. However, 2, 4-D was effective against broad-leaf weeds only.

Ethyl di-n-propylthiolcarbamate (EPTC) and other thiolcarbamate compounds are reported to control grasses, broadleaf weeds and sedges when used as pre-plant or lay-by treatments (Ghosh, 1963; Isleib, 1960; Kramer and Lederman, 1961; N. E. Weed Control Conf., U.S.A., 1961; Sawyer *et al*, 1960) at rates ranging from 4 to 6 pounds per acre. Dimethylester of tetrachloroterephthalic acid (Dacthal) and 2-chloro-4-diethylamino-6-ethylamino-3-triazine (Trietazine), at 4 pounds per acre, applied before crop emergence controlled all the weeds in potato (Proceedings of North Eastern Weed Control Conf., U.S.A., 1961).

In earlier experiments conducted by the authors (1963), 2, 4-dichlorophenyl, 4-nitrophenyl ether (Tok E-25), Propyl ethyl-n-butylthiolcarbamate (PEBC), and n-propyl-di-n-prophylthiolcarbamate (R-1607) showed promise for weed control in potato. In view of the problem in potato an experiment was laid out in 1964 using four herbicides, Tok E-25, EPTC, PEBC and Daethal.

MATERIALS AND METHODS

The experiment was laid out in a Randomized complete Block design with four replications. The net size of each plot was 26 ft. by 11 ft. The treatments included pre-emergence application of Tok E-25 at 4 and 8 lb (a i)/A., and Dacthal at 7 and 14 lb. (a i)/A. and pre-plant application of EPTC and PEBC, both at 4 and 8 lb (a e)/A.

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EPTC and PEBC were applied and immediately incorporated into the soil prior to planting. Potato tubers (Var. "phulwa") were planted on November 4, 1964, in three inch deep furrows spaced two feet apart. The tubers were covered with soil followed by planking. Tok E-25 and Dacthal were applied following planting. A light raking was given to Dacthal treated plots.

Observations were taken on weeds, with regard to number, species composition and weight, and on the potato crop, with regard to stand and yield of tubers.

Weed count was taken at 10-day intervals, by staking off 0.25^2 m. area at three places in each plot. Final weed counts were recorded from each plot after removing the potato haulms at harvest and the weight of weeds was also recorded. The number of potato plants per meter length were counted at three places in each plot to determine the stand of the crop. Yield of potato tubers were recorded for each plot at harvest. The crop was harvested on March 2, 1965.

RESULT AND DISCUSSION

Emergence of potato seedlings was completed in one month after sowing. Reading taken 51 days after planting, on December 21, 1964, showed the stand of potato plants to be uniform in all the plots. However, the seedlings in the EPTC and PEBC treated plots exhibited temporary deformity at emergence but recovered after a week or so.

Effect on weeds:—The weed stand, in general, was low in all the plots throughout the growing season. *Motha* (*Cyperus rotundus*) was the only dominant weed in the early stage of the crop. Other species of weeds appeared about two weeks following planting. Only EPTC and PEBC gave effective control of *motha* and other weeds as compared with the untreated check plots. Even 27 days after planting the number of weeds in plots treated with 8 and 4 lb/A. EPTC were 11 and 18 respectively, as compared to 21 and 22 in the case of 8 and 4 lb/A. PEBC, 86 and 75 in the case of 8 and 4 lb/A. Tok E-25, 134 and 86 in the case of 14 and 7 lb/A. Dacthal and 189 and 133 in the case of untreated check. Effective weed control from EPTC and PEBC is also reported by Isleib (1961), Kramer and Liederman (1961), and Swayer *et al* (1960). In the present investigation lower rates gave as effective weed control as higher rates. The results are summarised in Table 1.

EPTC and PEBC gave effective control of weeds throughout the growing season as evidenced from readings on stand and fresh weight of weeds at the time of harvest of potato (Table 2). Such effectiveness was not observed in the case of Tok E-25 and Dacthal. The effect of the herbicides was more revealing on the fresh weight of weeds than on the number of weeds per plot. While there was no marked difference in the effect of higher and lower rates of herbicides on the number of weeds per plot, higher rates resulted in lower fresh weight of weeds though not significant. While *motha* formed the predominant weed in all the treatments, *bathua* (*Chenopodium album*) was responsible for the major bulk (by weight). Other weeds present in the treatments were of secondary importance both from the point of view of number and weight.

Effect on potato tuber yield:—The potato tubers were harvested on March 2, 1965. The whole crop was severely affected by virus. The tuber size from all the plots, in general, was

TABLE 1. *Average number and species composition of weeds*

Treatments	No. of weeds/Sq. meter days after planting			Composition/Sq. meter* 27 days after planting				Remarks
	7 days	17 days	27 days	1	2	3	4	
T_0—Unweeded Control (*a*).	39	88	133	100	11	15	7	The weed flora comprised of Cyperus rotundus (Motha) only till the third weed count, (27th day after planting).
T_1—Unweeded Control (*b*).	35	78	189	117	24	28	20	
T_2—Tok 4 lb/A. ..	17	58	75	47	7	16	4	
T_3— ,, 8 ,, ..	22	60	86	75	1	8	0	
T_4—EPTC 4 ,, ..	0	0	18	1	2	14	1	
T_5— ,, 8 ,, ..	0	0	11	0	0	11	0	
T_6—PEBC 4 ,, ..	1	9	22	10	3	8	0	
T_7— ,, 8 ,, ..	0	0	21	2	2	16	0	
T_8—Dacthal 7 ,, ..	28	72	86	79	2	6	2	
T_9— ,, 14 ,, ..	29	94	134	118	0	13	3	
C.D. *at* 5% ..	24	53	54	..	..	..	..	

*Composition of weeds/meter 27 days after planting:
(1) Cyperus rotundus (Motha)
(2) Chenopodium album (Bathua)
(3) Clovers
(4) Miscellaneous—Vicia hirsuta (Akra), Anagallis arvensis (Krishnaneel), Launea asplenifolia (Jungli gobhi), Fumaria parviflora (Bangajar)

TABLE 2. *Average number and weight of weeds at harvest and the yield of potato tubers.*

Treatments	Weed composition/plot before harvesting			Total No. of weeds/plot	Composition by wt.			Fresh wt. of weeds Kg/plot	Yield of potato tubers Kg/Acre
	Motha	Bathua	Misc.		Motha	Bathua	Misc.		
Unweeded Control (*a*)	837.5	86.2	13.7	937.5	0.47	6.67	0.09	7.29	8544.0
Unweeded Control (*b*)	169.2	56.5	8.0	1753.7	0.24	4.51	0.05	4.69	8742.0
Tok E-25 4 lb/A	1999.7	15.7	1.5	2017.0	0.93	1.10	0	2.09	8269.8
Tok E-25 8 ,,	597.0	4.0	0.2	601.2	0.35	0.47	0	0.82	9320.7
EPTC 4 ,,	177.5	9.2	2.0	188.7	0.03	2.74	0	2.76	8742.0
EPTC 8 ,,	42.5	0.2	0	42.7	0.007	0.01	0	0.02	9716.7
PEBC 4 ,,	180.0	13.7	0.2	194.0	0.05	1.16	0	1.22	8833.4
PEBC 8 ,,	182.5	7.7	0	190.2	0.05	0.18	0	0.21	9731.9
Dacthal 7 ,,	1312.7	7.0	12.2	1332.0	0.44	0.38	0.04	0.89	7843.4
Dacthal 14 ,,	1175.5	0	6.7	1182.2	0.69	0	0	0.69	7752.0
C.D. at 5% ..				Not significant				3.89	1186.41

Miscellaneous weeds : Same as given in Table 1
Net plot size—11 ft. by 26 ft.

small. The three treatments registering highest yield of tubers, of 9731.9, 9716.7 and 9320.7 kg/A., were 8 lb/A. rates of PEBC, EPTC and Tok E-25, respectively. Tuber yield from the two unweeded check treatments, which did not receive any herbicide or weeding, were 8544.0 and 8742.0 kg/A. The difference required for significance (at P=0.05) was calculated to be 1186.41 kg/A. Tuber yield from Dacthal treated plots (at both 7 and 14 lb/A.) were lower (7843.4 and 7752:0 kg/A.) than the unweeded check, indicating an yield depressing effect of the chemical. The differences were however not significant. Neither was there any apparent injurious effect of Dacthal on the potato plants at any earlier stage.

Relatively good tuber yield from the unweeded check plots is ascribed to poor weed stands and therefore lack of severe crop weed competition. This also explains why significant increase in tuber yield were not obtained from the use of EPTC and PEBC, in spite of effective weed control at all stages of the crop. It is also seen from Table 2 that the fresh weight of weeds, rather than the weed population, tends to influence the reduction in tuber yield of potato.

SUMMARY

Four different berbicides, EPTC, PEBC, Tok E-25 and Dacthal were tested for weed control in potato. Pre-plant application of EPTC and PEBC gave effective weed control and higher tuber yield than the untreated check. Tok E-25 and Dacthal gave effective control of broadleaf weeds but not *motha*. Tuber yield in the Dacthal treated plots was lower than the untreated check. The weed intensity, in general, was poor in all the plots. Thus, lack of severe crop-weed competition did not result in significant yield differences, in spite of effective weed control obtained from EPTC and PEBC.

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Studies on the Effect of Plant Growth Regulators on the Rooting of Plum Cuttings in Himachal Pradesh

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INTRODUCTION

Prunus domestical popularly known as "Alu-Bukhara" or Plum is a common fruit in the Sub-Tropical and temperate regions of Himachal Pradesh. It is a fruit of commercial importance and is generally propagated vegetatively by budding and grafting on Peach (*Prunus persica* Batch) root-stocks which is more susceptible to bacterial gummosis. To overcome this problem as well as to find out the easiest method of propagation, attempts were, therefore, made to induce rooting in cuttings with the aid of plant growth regulators at the Fruit Research Station, Dhaulakuan, District Sirmur.

REVIEW OF PAST WORK

The common method of propagation of plum is by budding or grafting on suitable root-stock (6). Propagation by means of stem cuttings had not met with much success (7). The stem cuttings of some of the varieties of plum like Brompton, Myrobolan, Pershore and Victoria under temperate climatic conditions had given only 30 to 60 per cent. success in rooting when treated with growth regulating substances (8). High percentage of success could be obtained by Dixit N. N. 1956 (4) in the regeneration of shoots and roots by the stem cuttings of plum (*P. saliciana* Lindl) varieties Early round and Howe as influenced by three concentrations of B.I.B.A. The untreated cuttings generally failed to produce roots, although callus root initials, small shoots and leaves were developed. Highest degree of rooting and most vigorous shoots were developed on the cuttings which were treated with beta indole butyric acid at 30 ppm. concentration. A positive correlation between the leaf area and the root development was observed.

The varieties like Santa Rosa, Meriposa, Alpha and Large-late-yellow do not appear to have been tried earlier in this respect. The present studies were, thus, undertaken to find out an easier and more economic method of vegetative propagation of the above varieties. The resulting plants may thus be less susceptible to the gummosis disease.

MATERIAL AND METHOD

Thirty stem cuttings of equal girths, length, age and vigour were picked up at random from the heap of lateral twigs, cut out of four plants of each of the four varieties, viz. Santa-rosa, Large-late-yellow, Alpha and Meriposa about four weeks before the advent of the spring season. Thirty cuttings of each variety were tied in bundles and kept in moist sand for the information of callus, for a period of 20 days, after which they were taken out and washed with tap water to remove adhering sand. These bundles were then dipped in hormone solutions for a period of 20 hours with the basal ends of the cutting dipped up to a height

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of one inch. Solution of indole acetic acid, Alpha Naphthaline Acetic acid and a mixture of I.A.A.+Alpha N. A. A. (in equal proportions) prepared in three concentrations of 100, 200 and 300 p.p.m. according to the standard method followed by Pearse H. L. (1938) (9). After the treatment the cuttings were taken out, washed with distilled water and planted in pots containing fine sand and watered regularly for a period of eight weeks. Thus 1,080 ($120 \times 3 \times 3$) cuttings received hormone treatments and for control or no treatment (30×4) $=120$ cuttings were dipped in distilled-water for 20 hours after callus formation and planted in pots for rooting. After the lapse of eight weeks, allowed for rooting, all the cuttings were very carefully taken out of the sand without injuring their roots and examined for recording the following observations:

(1) No. of cutting which rooted successfully.
(2) No. of roots produced in each successful cutting.
(3) Length of roots produced in each successful cutting.
(4) No. of cuttings which survived and established into successful plants.

The data collected on the above four aspects were statistically analysed by the method of 'F' test. Percentage of successful cuttings were worked out and converted into angular transformation according to the formula 'P'=Sin 2θ (where P stands for percentage success, θ for angular transformation) for the purpose of valued comparison and statistical analysis. The conclusions derived from the transformed figures are equally valid for percentages. The length of roots in Centimetres per cutting were worked out by dividing the total length of roots by the total number of successful cuttings in each treatment.

I. PERCENTAGE OF SUCCESS IN THE ROOTING OF CUTTINGS:

All the hormone treatments induced higher rooting (statistically) when compared with Control. From the analysis of data in the table 1 and I(A) it was found that the values of success in the treated cuttings, in all the treatments taken together were 45.05% (or 40.63 on θ basis) against 2.47% in the control. The critical difference between the means of the treatments and the control mean, being 12.84. The treatment on the whole proved significantly superior to no-treatment.

So far as the comparative efficiency of the various hormone treatments was concerned, it was found that differences within the various hormones treatments were statistically insignificant. Maximum rooting 50.8% was obtained in Alpha N.A.A. treatment.

II. NUMBER OF ROOTS PER CUTTING:

In respect to the number of roots per cutting, the trends obtained were the same as in the study of the percentage of success i.e. the hormone treatments on the whole were significantly superior (8.73 against 0.6) to control. There were no significant differences between the three treatments. However, Alpha N.A.A. treatment appeared to produce higher number of roots.

III. LENGTH OF ROOTS PER CUTTING:

As indicated in the Table 1, the grand mean of the length of roots per cutting being 27.74 cm. in the treatments against 0.11 cm. in the control, the treatments on the whole

were significantly superior to no-treatment. The differences in the mean of the lengths in each hormone treatment were, however, insignificant showing that all the hormones were equally effective.

A. Effect of Concentrations of Hormones

The effects of three concentrations, viz. 100 p.p.m., 200 p.p.m. and 300 p.p.m. of the three hormone treatments studied from three aspects (the percentage of success, the number and length of roots per cutting, table '1') showed no significant differences in the responses. It indicated that the range of concentrations tested (100, 200 and 300 ppm) was rather narrow. Wider differences over a longer range in lower concentrations might show some significant differences and prove economical.

B. Varietal Responses to Hormones

Four varieties of Plum Santarosa, Large-late-Yellow, Alpha and Meriposa responded to hormone treatments in varying degrees. The differences in their behaviour were significant statistically. Santarosa and Large-late-Yellow behaved similarly and responded best to the various treatments. The Alpha variety ranked next in its response while Meriposa variety exhibited a poor response (Table-1).

From the point of view of success in the percentage of rooting, as well as the length of roots, the relative positions of the varieties were :—

(*a*) *Percentage of success* (*transformed values*).

Santarosa =	Large-late-Yellow	>	Alpha	>	Meriposa
52.28	48.83		36.08		12.24

(Critical difference=9.95).

(*b*) *Length of Roots per Cuttings*:

Santarosa =	Large-late-Yellow	>	Alpha	>	Meriposa
41.02 cm.	39.99 cm.		23.9 cm.		6.04 cm.

(Critical difference=9.68).

(*c*) *Number of Roots per Cutting:*

It was found that in respect of number of roots, three varieties Santarosa, Large-late-Yellow, Alpha behaved almost equally well statistically and responded better than Meriposa variety to the various treatments.

The relative positions of the varieties were found to be—

Santarosa =	Large-late-Yellow	=	Alpha	>	Meriposa
11.43	11.29		9.82		2.35

(Critical difference=3.96).

(*d*) *Interactions:*—

Interactions between varieties and hormones ($V \times H$) as well as between varieties and concentrations ($V \times C$) and hormones with concentrations ($H \times C$) were studied and were

TABLE 1. *Showing % Success in rooting, No. of roots and length of roots per cutting and variatal to hormones treatments.*

Varieties	SANTAROSA				LARGE-LATE-YELLOW				ALPHA				MERIPOSA				Total and means of all varieties taken together success in rooting			
	Success in rooting		No. of roots	Length of roots	Success in rooting		No. of roots	Length of roots	Success in rooting		No of roots	Length of roots	Success in rooting		No of roots	Length of roots				
Treatments	ψ	%			ψ	%			ψ	%			ψ	%			ψ	%	No of roots	Length of roots (cms)
I.A.A.																				
100 ppm. ..	54.69	66.6	8.4	41.57	50.77	60.0	5.7	26.50	10.44	3.3	4.0	4.40	18.43	10.0	3.7	11.4	134.33	139.9	21.8	83.87
200 ppm. ..	56.79	70.0	8.6	45.75	68.53	86.6	9.4	43.70	31.05	26.6	3.5	7.10	10.44	3.3	1.0	1.10	166.81	186.5	22.5	97.65
300 ppm. ..	28.86	23.3	13.7	40.44	54.69	66.6	14.5	68.82	37.21	36.6	5.6	21.40	10.44	3 3	3.0	3.50	131.20	129.8	36.8	134.16
Total ..	140.34	159.9	30·70	127.76	173.99	213.2	29.60	139.02	78.70	66.5	13.10	32.90	39.31	16.6	7.7	16.00	432.34	456.2	81.10	315.68
Means ..	46.78	53.3	10.23	42.59	57.99	71.06	9.86	46.34	26.23	22.16	4.36	10.96	13.10	5.53	2.56	5.33	36.03	38.01	6.76	26.30
Alpha N.A.A.																				
100 ppm. ..	75.01	93.3	14.8	47.10	61.07	76.6	9.3	25.70	45.00	50.00	8.8	23.75	28.86	23.3	2.0	5.27	209.94	243.2	34.9	101.82
200 ppm. ..	71.57	90.0	18.0	54.90	41.15	43.3	6.9	7.01	43.05	46.6	26.4	39.22	18.43	10.0	4.0	6.43	174.20	189.9	55.3	107.56
300 ppm. ..	61.07	76.6	9.3	30.02	52.72	63.3	16.8	28.22	37.21	36.6	14.45	25.57	0.00	0.0	0.0	0.0	151.00	176.5	40.55	83.81
Total ..	207.65	259.90	42.10	132.02	154.94	183.2	33.00	60.93	125.26	133.2	49.65	88.54	47.29	33.3	6.0	11.70	535.14	609.6	130.75	293.19
Means ..	69.22	86.63	14.03	44.00	51.64	61.6	11.00	20.31	41.75	44.4	16.55	29.51	15.76	11.1	2·0	3.90	44.59	50.8	10.90	24.43
I.A.A. and Alpha N.A.A.																				
100 ppm.	58.89	73.3	9.8	33.40	52.89	73.3	10.02	58.25	50.77	60.0	9.02	31.00	14.88	6.6	1.5	12.43	183.43	213.02	30.70	135.08
200 ppm. ..	54.69	66.6	9.5	15.50	50.77	60.0	14.8	56.67	46.89	53.3	14.8	24.45	10.44	3.3	1.0	4.0	162.79	183.02	41.01	136.62
300 ppm. ..	50.77	60.0	10.8	24.50	39.23	40.0	14.0	45.12	48.79	56.6	1.7	38.25	10.44	3.3	5.0	10.20	149.23	159.9	31.5	118.07
Total ..	164.35	199.9	30.10	109.40	148.89	173.3	39.00	160.04	146.45	169.9	25.70	93.70	35.76	13.2	7.5	26.63	495.45	556.3	102.30	389.77
Means ..	54.78	66.6	10.03	36.46	49.63	57.76	13.00	53.34	48.81	56.63	8.56	31.23	11.92	4.4	2.5	8.87	41.28	46.36	8.53	32.48
G Means ..	52.28	..	11.43	41.02	48.826	..	11.29	39.99	36.08	..	9.827	23.904	12.236	..	2.35	6.04	40.63	45.05	8.73	27.74
Control ..	10.44	3.3	1.00	0.02	10.44	3.03	1.00	0.17	10.44	3.3	0.36	0.06	0.00	0.0	0·0	0.0	31.32	9.9	2.36	0.43
Grand Total ..	522.78	..	103.09	369.38	488.26	..	102.6	360.16	360.85	..	88.08	215.20	122.36	..	21.02	54.33	1494.25	means 2.47	means 0.6	means 0.11

N B—Figures under column ψ represent transformed figures by the formula $P = \sin^2 \psi$ where P=percentage of success in rooting, ψ is angular transformation.

TABLE I(A)—*Details of Analysis of variation (Percentage of success in rooting).*

Variation due to	D.F.	T.S.S.	M.S.S.	F.	Standard error	Critical difference
Concentration ..	2	418.79	209.40	1.77	..	..
Hormones ..	2	447.94	223.97	1.89	..	..
Concentration vcs Hormones	4	364.70	91.18	0.77	..	..
Control versus treatments ..	1	3874.67	3874.67	32.74**	6.26	12.84
Variety ..	3	9868.56	3289.52	27.79**	3.44	9.95
Error ..	27	3195.43	118.35	..	..	..
Total ..	39	18170.08	465.90	..	..	..

TABLE- I(B)—*Analysis of variance (Average number of roots per cutting).*

Variation due to	D.F.	T.S.S.	M.S.S.	F.	S.E.	C.D.
Variety (V) ..	3	501.25	167.08	11.10**	1.29	3.96
Hormone (H) ..	2	103.44	51.72	3.44	..	..
Concentrations (C) ..	2	40.89	20.45	1.36	..	..
V × H ..	6	172.52	28.75	1.91	..	..
V × C ..	6	148.45	24.74	1.64	..	..
H × C ..	4	63.99	16.00	1.06	..	..
Error ..	12	180.57	15.05	..	..	..
Total ..	35	..	..	..	..	..

TABLE-I(C)—*Analysis of variance (Length of roots per cutting).*

Sources of variation	D.F.	S.S.	M.S.S.	F.	S.E.	C.D.
Variety (V) ..	3	7311.46	2437.15	26.47**	3.15	9.68
Hormones (H) ..	2	425.63	212.82	2.31	..	..
Concentration (C) ..	2	19.73	9.87	0.22	..	..
V × H ..	6	2285.82	380.97	4.14**	5.54	17.03
V × C ..	6	947.95	157.99	1.72	..	..
H × C ..	4	447.70	111.93	1.22	..	..
Error ..	12	1104.91	92.08	..	..	..
Total ..	35	..	..	..	..	..

**Highly significant.

found to be statistically significant in the former case (V×H) only. Table 1 (C). The critical difference due to (V×H) was 17.03. From the figures it was seen that the interaction of Large-late-Yellow variety with the mixture of two hormones was maximum, producing largest roots (53.35 cm.) which was statistically similar to the interaction of Santarosa variety with all the three hormones treatments, producing 44.00, 42.59 and 36.46 cm. long roots in Alpha N.A.A., I.A.A. and the mixture treatments respectively. Also the interaction of Large-late-Yellow with I.A.A. producing 46.34cm. long roots was as good as in the above case.

IV. SURVIVAL OF SUCCESSFUL CUTTINGS

Soon after the observations on all the successful cuttings in respect of rooting were taken and recorded, the treated cuttings were dipped in a dilute solution of Ammonium Sulphate manure for a short period (i.e. one hour) and replanted in properly prepared and manured beds during the month of April. Observations on the number of cuttings which could successfully thrive into full grown plants were recorded after replanting and the percentage of survival of successful cuttings were worked out for each variety.

It was noted that there were few gaps in the observations of two varieties viz. Large-late-Yellow and Meriposa due to the fact that during the course of examination in some treatments some injuries were caused to their roots with the result that these cuttings could not grow and survive. These studies were hence confined to other two varieties, i.e. Santarosa and Alpha only.

Although there was higher survival in Alpha variety yet the differences between this and Santarosa variety was insignificant statistically. The survival percentages were on an average 42% in Alpha and 35% in the Santarosa variety. The success in the survival of plants in the Large-late-Yellow variety was fairly high, while it was almost nil in the Meriposa variety. The analysis in respect of responses exhibited by various hormones treatments, concentrations and the varieties as well as their interactions did not show any significant differences in the survival studies.

SUMMARY

Three hormones—(i) Indole Acetic Acid, (ii) Alpha Napthaline acetic acid and (iii) A mixture of these two hormones were used in three concentrations (100, 200 and 300 ppm) to induce rooting in the cuttings of four varieties (Santarosa, Large-late-Yellow, Alpha and Meriposa) of plum growing in Sirmur District of Himachal Pradesh.

1. The results obtained showed that all the three hormone solutions were successful in inducing rooting in all the four varieties and were on the whole highly significant when compared with the control.

2. So far as the comparative study of the three hormone solutions, in all the varieties taken together were concerned, the differences in their effect were not significant statistically.

3. The trends, however, showed that amongst the hormones, Napthaline acetic acid appeared more effective than Indole—acetic acid used singly (except in respect of length of roots).

4. The range of concentrations (100, 200 and 300 ppm) tested did not show significantly different effects. The variations in the range of concentrations seemed to be too small to produce different effects.

5. Studies on the responses of varieties to different hormone treatments showed on the whole that two varieties—Santarosa and Large-late-Yellow behaved similarly and responded most favourably to all the three treatments. Alpha variety ranked next, while Meriposa variety responded most poorly. The differences in these responses were statistically significant. The position of the four varieties in respect of percentage of success in cuttings and the length of roots per cutting were Santarosa=Large-late-Yellow>Alpha>Mariposa. In respect of number of roots per cutting only, however, the Alpha variety also approached nearer to Large-late-Yellow and Santarosa statistically. Meriposa variety was in all aspects the worst variety in its responses to hormone treatments.

6. The study of the interactions of the varieties with hormones (V $\times$ H) and of the varieties with concentrations (V $\times$ C) and of hormones with concentrations (H $\times$ C) showed that they were significantly different only in one combination i.e. (V $\times$ H).

7. Studies on the survival of successful cuttings establishing themselves into full grown plants showed that the cuttings of Santarosa, Large-late-Yellow and Alpha varieties could establish successfully, while Meriposa cuttings failed to do so. The differences in their success, which could be studied in two varieties only i.e. Santarosa and Alpha were not found significant statistically.

These studies indicate tentatively that it is possible to propagate plums by means of stem cuttings successfully, if they are treated with Alpha N.A.A. or I.A.A. or in the combination of the two hormones in equal proportion before planting. The varieties most suited to sub-tropical conditions prevalent at the fruit Research Station, Dhaula Kuan for such propagation are Santarosa and Large-late-Yellow.

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Para Grass

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Origin and History:—

Para grass is a native of South America and West Africa. Although a native of Brazil, yet its cultivation for fodder purposes has been extended to tropical and sub-tropical countries like Ceylon, Mauritius, West Indies, Australia, Philippines, Mexico and India. It was introduced into Queensland about 1880 and since then it has been widely planted along the eastern coastal plains from Cooktown to the southern border. This water loving grass was introduced into India at Poona from Ceylon in the year 1894.

Botanical description:—

Botanically it is known as *Brachiaria mutica*. In Queensland it is popularly known as panicum muticum or giant couch. The other common names of this grass are Mauritius grass or buffalo grass.

It is a coarse perennial grass, growing to a height of 90 to 122 cm. The root system is fibrous and roots sometimes go 90 to 122 cm. deep in the soil. Young plants first produce stout runners which grow along the surface of the ground and form a shallow root system at each joint. In the initial stage of propagation in a new place, plants run on the ground like a creeper some 2.43—3.04 meter distance producing roots and shoots at each node. The stems are hollow and nodes hairy but are non-irritating. The leaves are 10 to 30 c.m. long and 6 to 16 mm. wide. The leaf blade is glabrous and the margins are scabrid.

The flower heads are produced in profusion only in tropics. The inflorescene is produced on erect stalks and the flowered head is yellowish green, turning brown as the seed ripens.

Climate:—

Para grass is well-suited to warm and humid climate of tropical India. It thrives well in sub-tropical India also but being sensitive to cold, it remains non-productive during winter months. The grass needs moderate to high temperature during its period of growth. It does not grow below a temperature of 40° F. It grows well in medium to heavy rainfall areas since its requirement for water is very high.

Once established, para grass continues to grow for several years, anything over 10 years. At Adarsh Dugdhayan in Palgahar (Maharashtra State) para grass was established in 1947 and continued for more than 10 years without deterioration in yield. This is an economical aspect in the cultivation of Para grass.

Soil:—

Para grass prefers areas which remain moist, as in waterlogged and low lying areas. Thus it grows well on banks of tanks and ponds and ditches. It can even remain under water for a long period.

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It grows on a variety of soils from sticky deep black soils to light and shallow soils. It also does well in well-drained soils and even it can grow on saline soils.

In general, Para grass will thrive on any soil type where soil moisture is consistently high.

Preparation of field:—

For planting Para grass, the field should be heavily manured at the rate of 40 to 50 cart load of farm yard manure and thoroughly mixed. To obtain a good seed bed the field needs to be ploughed a couple of times by improved plough and planked once.

Time of sowing:—

Under irrigated conditions, planting of para grass can be undertaken at any time during the year, but preferably in the spring so as to give the crop the benefit of an early start. Under rainfed conditions, however, it would be planted after the commencement of the monsoons. The plant during this season establishes itself quickly and induce early cutting. Planting in cool months should not be done.

Method of Planting:—

Para grass, being a shy seeder, is generally established either by stem cuttings or root stocks. Matured stem cuttings of 20—30 cm. long having 2 to 3 nodes are good and cheap for planting. These cuttings are to be dibbled 5 to 8 cm. deep so that at least one node is covered by soil and spaced approximately one foot apart row to row and plant to plant. Spacing may be increased upto 45 cm. × 45 cm. apart. For an early stand the planting is generally done at a closer distance. Close planting brings about the erect growth earlier than when wider planting is practised. Rooted runners give quicker establishment than ordinary cuttings.

If there is no rain, irrigation should be given immediately after planting. Subsequent irrigations should be given at an interval of 10 days if there is no rain.

Seed rate:—

In Queensland, sowing of well-filled seed made at the rate of 1-2 Kg per acre, produced good stand. About 8,000 to 10,000 cuttings are required per acre.

Manuring:—

This grass being potentially more productive than rhodes, guinea or napier grasses, very liberal manuring is necessary. On ordinary soils, a basal dose of 30 to 40 cartloads of farm yard manure, compost or sludge, followed by a top dressing with about 70 Kg. of amm. sulphate or manure mixture after every second or third cut is essential for maximum yield or about 10 to 15 cartloads of cattle manure or sludge manure per acre supplemented by 2.25—3.00 quintals of ammonium sulphate per acre will result in better yields. The fertilizer can be applied in three or four equal lots commencing with spring. Cowpea during Kharif and vetch (vicia sativa) during Rabi can be grown successfully in mixture with para grass.

Interculture:—

Interculture of this grass is more essential than of any other cultivated perennial grass, as the land sown with it generally gets sod bound. For this purpose the land should be opened up by light ploughing at least once each year. Field must be kept free of weeds.

Irrigation:—

The crop does not need any irrigation where the monsoon is normal and regular otherwise the grass has to be irrigated. For irrigation, furrows are opened at every 6—9 meters apart depending upon the slope of the land and beds prepared 6 meters apart between furrows.

Normal interval between two irrigations should not exceed 15 days in summer in deep black soils, this period could be extended without appreciable deterioration in yield.

In case the available water is not sufficient to irrigate the whole area under para grass during summer months, a portion of it may be left out without irrigation. The unirrigated grass would look dried up temporarily but with first shower of rain, new shoots come out and a good crop of 7.5 cm. height will be ready within 3 weeks of rains.

Cuttings:—

The grass becomes ready for the first cutting in about three months after planting. The subsequent cuttings may be taken once in a month or even at an interval of 6 weeks depending upon the climate, the frequency of irrigation and correct manuring.

Para grass grows luxuriently during April, May, June, July and August, when there is warm and humid climate. During this period crop is cut at every four weeks interval. During the other periods it can be cut at an interval of 5 to 6 weeks.

Under a well-manured plot and irrigated with wash water there will be 9 to 10 cuttings during the years. Under well water irrigation 6 to 8 cuttings are available.

It would be better to cut the grass close to the ground. If the grass is not harvested for a long time after it has grown 3 ft. in height, it lodges. If the crop is harvested when there are dew drops in it, cattle do not eat the grass well. One therefore should wait till the dew drops evaporate and leaves become dry.

Yield:—

Para grass yields well and responds to heavy manuring. The average yield in an eight year trial at Poona between 1894 to 1902 was nearly 13 tons fodder per acre per year, which compares favourably with yield obtained in Florida.

At Coimbatore, with 40 cartloads of F.Y.M. as a basal dressing and a top dressing of 20 cartloads of compost with 45 Kg. of amm. sulphate after every second cut, an average yield of 25-30 tons per acre per year was recorded. With sewage irrigation in Bengal area, over 50 tons per acre per year have been obtained in 12 cuts, while at Aarey Milk Colony a record yield of over 80 tons per acre per year in 12 cuts has been obtained with irrigation from cattle shed wash. The yield compares favourably with those obtained in Fiji and Hawaii. A normal crop yields 150—200 quintals green grass per acre in 8 cuttings, or more per year.

Comparative annual yields of the different grasses at Hasserghatta Farm, Mysore in Kgs. per acre

Serial number	Popular name	Fresh	Dry matter yield
1	Para grass	27,966	6,996
2	Natal grass	11,187	2,796
3	Giant star	11,187	2,796
4	Woolly finger	16,780	4,170
5	Rhodes	22,370	55,933
6	Millet grass	16,780	4,169
7	Kudzu leaves	16,780	4,169
8	Giant Napier	44,746	13,424
9	Sudan grass	27,966	8,390
10	Guinea	33,560	10,068
11	Spear grass	2,034	508
12	Dub grass	1,017	254

Feeding Value:—

The grass is very palatable and reported to be eaten by all classes of livestock with the same persistency and regularity in all stages of maturity of the crop. It is rich in protein but poor in phosphorus and calcium content. It contains about 5 to 6 per cent. protein, and C_aO and P_2O_5 are at 0.76 and 0.49 per cent. respectively. The nutritive value can be considerably improved by growing it mixed with velvet bean or centrosema, a practice followed in Gaum and Australia respectively. The chemical composition of para grass is as follows:—

Ingredients	Hay on dry basis in %	Green in %
Crude protein	9.60	7.28
Ether extract	2.00	1.04
Crude filne	34.95	30.76
Nitrogen free extract	41.85	48.34
Total ash	11.60	12.58
Calcium	0.365	0.57
Phosphorus	0.155	0.30

Uses:—

In Gaum para grass is used for reclaiming newly cleared areas, old lands, and low lands. It is extensively used in the coconut plantation in Panama and Gaum. The grass is utilized in Florida and other countries as a soiling, hay and pasture crop. As a soiling crop the grass is generally cut when it attains a height of 1—1.25 meter before it gets woody. Although the hay is considered rather coarse, it is considered to be of excellent quality. It can stand moderately heavy grazing and can carry one to two animals per acre for a period of nine to ten months, as has been recommended in Florida and Gaum. In India however, para-grass is mainly utilized for soiling purposes. Recent trials conducted by the I.A.R.I., New Delhi have shown that highly saline lands can be utilized profitably by growing this grass for fodder.

Pest and Diseases:—

Para grass is comparatively free of serious pests and diseases. Only army worms have been observed so far. This pest can be controlled effectively by dusting 10% gammaxane dust at 10 to 15 lb. per acre.

Economic Importance:—

(1) The grass grows well both on well-drained soils and water logged soils as well.

(2) It is a quick growing perennial grass and easy to cultivate.

(3) As regards gross yield of para grass, it compares very well with any of the cultivated grasses like guinea and napier. It surpasses all other uncultivated natural grasses like spear and dub grasses.

(4) It is palatable and nutritious to cattle. It is also a soil builder.

Due to these advantages, para grass has become very popular in different parts of the country particularly in the hands of dairy farmers. Bombay, Madras, Coorg, Bihar, Assam and Manipur have reported very satisfactory results with para grass.

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Aerial Tuber Development in Potato Induced by Dimethyl Ester of Tetrachloroterephthalic Acid (Dacthal)

A. K. Ghosh[1] and P. N. Pande[2]

In normal potato plants tubers arise below the ground surface from swellings at the tips of stolons. Stolons are developed in the axils of scale leaves on the underground portion of stem. Tubers and stolons, being modified stem, exhibit typical stem structure.[1]

Dimethyl ester of tetrachloroterephthalic acid (Dacthal) was used as a pre-emergence herbicide in potato (var. K-122) at 7 and 14 lb. rates per acre. The chemical was applied immediately after sowing potato. Whole tubers and cut pieces of potato were sown in separate plots.

It was observed at the time of harvest (Feb., 1966) that 10 per cent. of the plants from plots sown with cut pieces had developed aerial tubers in addition to the underground tubers. No aerial tubers were formed in plots sown with whole tubers. The aerial tubers were not only formed on the main stem, just above the ground surface (Fig. 1), but also on the leaf axils of stems (Fig. 2) far above the ground surface. The apex of a number of stems terminated in a small tuber. Information on such abnormal behaviour in potato seems to be lacking, except for a single casual mention.[2]

The eyes on the aerial tubers were well marked. The apical eyes on several tubers had already sprouted, showing that dormancy had been overcome (Fig. 2). While many of the

Fig. 1. A potato plant showing a cluster of tubers on the main stem above the ground surface.

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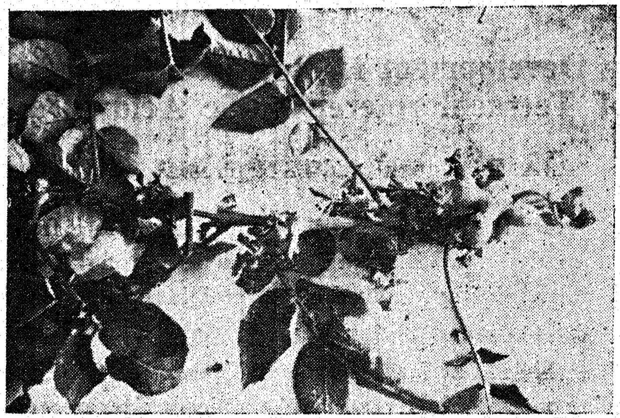

Fig. 2. A potato stem showing sprouted tubers formed on leaf axils.

aerial tubers had developed green colour, a good number of them were devoid of the same and had the appearance of normal underground tubers.

A commercial formulation of Dimethyl ester of tetrachloroterephthalic acid (Dacthal W-75) was used in the above trial.

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Effect of Nitrogen, Seed Size and Spacing on the Grades of Potato Tubers

R. N. Sinha, J. P. Singh and A. Ram*

Tuber grades in potato are important because different grades are required for different purposes. For example, big tubers are preferred for table purpose, medium ones for seed and small for *chats*. Besides, there are many farmers who are interested in potato seed production and their primary aim is to get more of tubers of seed sizes than of table and *chat* sizes. There are also many farmers who want more of big size potatoes for sale for table purpose at high price.

Little work seems to have been done on the factors influencing the production of different grades of potatoes. Therefore, investigations were carried out at the Bihar Agricultural College Farm, Sabour to find out the effect of different doses of nitrogen and different seed sizes and spacings on the yields of different grades of potato tubers.

MATERIALS AND METHODS

The experiment was conducted in split-plot design with the following treatments:

Main plot treatments:

Nitrogen

N_0—0 kg. per hectare
N_1—45 kg. per hectare
N_2—90 kg. per hectare
N_3—135 kg. per hectare

Spacing

S_1—10 cms. plant to plant
S_2—15 cms. plant to plant
S_3—20 cms. plant to plant

Sub-plot treatments:

Seed size (in terms of weight in gms.)

W_1—5 gms. seed tuber
W_2—10 gms. seed tuber
W_3—15 gms. seed tuber
W_4—20 gms. seed tuber.

The variety of potato selected for the study was D.R.R., which is grown most extensively in Sabour region. The spacing between rows was kept at 0.6 meter in all the cases. A basal dose of 185 quintals F.Y.M. per hectare was applied at the time of preparation of land. All the experimental plots received 83.5 kg. P_2O_5 and 45 kg. K_2O per hectare at the time of

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planting. Harvested tubers were graded into four categories *viz.*, big, medium, small and *jharna* according to the size of tubers measured in terms of *soots** as given below:

Grade of tubers	Diameter of tuber in *soots*
Big size	above 9
Medium size	above 7 and up to 9
Small size	above 4 and up to 7
Jharna size	up to 4

RESULTS AND DISCUSSION

The data relating to the mean yields of different grades of tubers as influenced by different treatments are presented in Table 1.

TABLE 1.—*Yields of different grades of tubers in kg. per plot*

Treatments	Big size tubers	Medium size tubers	Small size tubers	*Jharna* size tubers
N_0	97·31	2.97	3·85	1.66
N_1	10.55	3.98	4.50	1.83
N_2	11.64	4.36	5.11	1.90
N_3	12.86	4.67	5.70	2.44
"F" test	Sig.	Sig.	Sig.	Sig.
S. Em.	$\pm$0.269	$\pm$0.095	$\pm$0.053	$\pm$0.063
C.D. at 5%	0.59	0.20	0.11	0.14
W_1	12.14	3.00	3.16	1.90
W_2	11.55	3.90	4.00	2.04
W^3	10.44	3.99	5.73	2.18
W_4	10.25	4·70	6.24	2.45
"F" test	Sig.	Sig.	Sig.	Sig.
S. Em.	$\pm$0.248	$\pm$0.113	$\pm$0.076	$\pm$0.062
C.D. at 5%	0.49	0.23	0.15	0.12
S_1	10.54	4.25	5.00	2.34
S_2	11.20	3.95	4.95	1.95
S_3	11.50	3.56	4.40	1.35
"F" tiest	Sig.	Sig.	Sig.	Sig.
S.Em.	$\pm$0.233	$\pm$0.081	$\pm$0.047	$\pm$0.11
C.D. at 5%	0.51	0.17	0.10	0.24

* 8 *Soots* =1" or 2.54 mm.

Sig.—Significant at 5%.

A perusal of the above table would reveal that nitrogen treatments produced significantly more yield of all the four grades of tubers than the no-nitrogen (control) treatment and that with an increase in the nitrogen dose, there was significantly progressive increase in the yield of all the four grades of tubers also. Similar result has been reported by Kapoor (1950) and Suri (1963). As regards effect of different seed sizes on the grades of tubers, it would be seen that small seed tubers produced the largest proportion of big-sized tubers per plot and with the increase in the size of the seed tubers, the yield of big-sized tubers progressively decreased.

But the trend was just opposite in case of medium, small and *jharna* size tubers. With increase in the size of planting material, the yields of medium, small and *jharna* size tubers progressively increased. The reason for more yield of big-sized tubers by planting small-sized seed can be assigned to the fact that small seeds produced less number of stems per hill and consequently less number of tubers and thus they developed fully resulting in big size. On the other hand, big seeds gave rise to more number of stems per hill and consequently more number of tubers resulting in competition between tubers which hampered their fullest development. The results are in agreement with those of Rieman *et al.* (1953), Toosey (1958) and Birecki and Roztropowicz (1963).

So far as influence of different plant spacings on the production of different tuber grades is concerned, the yield of big-sized tubers increased progressively with increase in spacing. The trend of the production of medium, small and *jharna* size tubers was quite opposite to that of big size tubers. In other words, increase in spacing resulted in decrease in the yields of these three tuber grades. A decrease in the proportion of big-size tubers in narrower spacing resulted due to overcrowding of tubers in limited spacing offering obstacle in their proper development. But quite opposite situation prevailed in wider spacing which yielded more proportion of big-sized tubers.

SUMMARY

The investigations were undertaken with a view to study the effect of different doses of nitrogen and different seed sizes and spacings on the grades of potato tubers. The important results are summarised below:

(1) Small seed size produced more proportion of big-sized tubers in comparison to bigger seed size. But the yields of medium, small and *jharna* size tubers increased with the increase in size of seed tubers.

(2) Increase in plant spacing resulted in increase of bigger-size tubers.

(3) Increase in the doses of nitrogen resulted in progressive increase of all the four grades of tubers.

Thus, when big-sized tubers are desired comparatively smaller seed tubers should be planted at wider spacing. But when the production of medium and small tubers be the objective, the choice should be comparatively big seed tubers planted at narrower spacing.

ACKNOWLEDGEMENT

Authors are grateful to Sri R. S. Roy, Principal, Bihar Agricultural College, Sabour for providing necessary facilities for the investigation.

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A Preliminary Study on Interspecies Grafting in Genus Carissa

Gauri Shanker*

The members of the genus carissa are commonly cultivated for hedges purposes around the gardens and occasionally in the orchards for fruits. The *Carissa carandas*, *C. grandiflora*, *C. bispinosa*, *C. spinarun*, and *C. pancinervia* produce excellent crop which make excellent jelly, pickle, preserve and refreshing drinks. Out of these, *C. grandiflora* and *C.carandas* are quite popular in India.

Nearly all the species of carissa are commercially multiplied by seed. Vegetative propagation such as cutting and air-layering in *C. carandas*, *C. grandiflora* and *C. bispinosa* have been studied (1, 2, 3). There is no information available regarding possibilities of grafting and its limit, in this genus except for Hayes (4) who quoted Farminger, that *C. grandiflora* (Natal plum) is more productive when grafted on *C. carandas* (Karounda). Therefore, studies were undertaken at the Allahabad Agricultural Institute during the year 1965 to explore the possibilities of interspecies grafting in three species of carissa, *viz.*, *C. grandiflora*, *C. bispinosa* and *C. carandas*.

Seedlings $1\frac{1}{2}$ to 2 years old of each species mentioned above were approach grafted in the month of August. The various combinations tried are given in the table. The scions were detached from the mother plants after 45 and 60 days respectively from the date of operation

Table showing the percentage of success and optimum time for union in different combinations

Serial No.	Scion/rootstock combinations	No. of plants grafted for days 45	days 60	Percentage of success after 30 days 45	60	Survival of grafts after 120 days 45	60
1	*C. carandas/ C. carandas*	4	4	100	100	100	100
2	*C. carandas/C. grandiflora*	4	4	100	100	100	100
3	*C. carandas/C. bispinosa*	4	4	75	100	75	100
4	*C. grandiflora/C. grandiflora*	4	4	100	100	100	100
5	*C. grandiflora/C. carandas*	4	4	100	100	50	50
6	*C. grandiflora/C. bispinosa*	4	4	50	100	0	0
7	*C. bispinosa/C. bispinosa*	4	4	0	0	0	0
8	*C. bispinosa/C. grandiflora*	4	4	50	100	50	50
9	*C. bispinosa/C. carandas*	4	4	100	100	50	50

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to determine the optimum time required for completing the union. The first observations were recorded after 30 days from the date of separation to give away the doubts that the union is superfluous. For the survival of the grafts observations were recorded after 120 days.

Interspecies grafting in three species,viz. *C. carandas*, *C. grandiflora* and *C. bispinosa* and their reciprocal combinations were tried. The optimum time required for completing the union varied from 45 to 60 days except for *C. bispinosa* on its roots. Observation recorded after 120 days reveals that all plants of *C. grandiflora* on *C. bispinosa* died suggesting the incompatibility. Fifty per cent. plants of *C. bispinosa* on *C. carandas* and *C. grandiflora* root-stocks also died. Half of the plants *C. grandiflora* on *C. karandas* also died.

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Origin of New Roots in the Stem Cuttings of White Mulberry (*Morusalba*, Linn)*

SUSHIL KUMAR SRIVASTAVA**

The propagation of plants is a fundamental occupation of mankind. The scope of vegetative propagation by cuttings is very great not only in the limited sphere of plant breeders in maintaining purity but also in the field of commercial nurserymen as to why cuttings are the easiest amongst all the vegetative methods of propagation.

The initiation of root primordia and its development (preformed root initials) in stem cuttings are the only two important manifestations for a successful cutting. There is a great controversy between various investigators regarding the region of origin of new roots in stem cuttings. The origin of roots in stem cuttings after planting in the soil without preformed root initials have been reported to be in various tissues and it seems that it varies from species to species.

Priestley (1926) reported that the adventitious roots arose in cambium after callus development was complete. Rake (1957) noticed in hard wood cuttings of goose-berry that roots occurred on a point opposite to the bud gaps on the stem and also just above the cutting base. Fuji (1955) working on wine cuttings observed that all root primordia arose from between the outer part of the newly formed xylem and phloem region. Esau (1958) stated that such roots were initiated in the vicinity of differentiating vascular tissues of the organ which gave rise to them. Singh *et al* (1961) reported that roots originated through callus tissues in phalsa cuttings.

In the view of above facts it was felt desirable to study the "Origin of new roots in the stem cuttings of white mulberry (*Morus alba*, Linn)"

MATERIAL AND METHODS

Permanent microtomical slides of normal, callusing and rooted cuttings were prepared on the technique of Johansen (1940) in the laboratory of the school of Plant Morphology, Meerut College, Meerut.

The material was fixed in formaline-aceto-alcohol for two days. Spencer's sliding microtome was used for cutting the sections. The knife was adjusted properly and the sections were cut at 25 microns except the callusing cuttings (at 35 microns). Sections were double stained with the help of 1% safarine and 1% fast green and mounted in Canada-Balsom.

EXPERIMENTAL FINDINGS

The findings are summarised in the Table 1.

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* A summary from a thesis submitted to Agra University for M. Sc. (Ag) Degree in 1962

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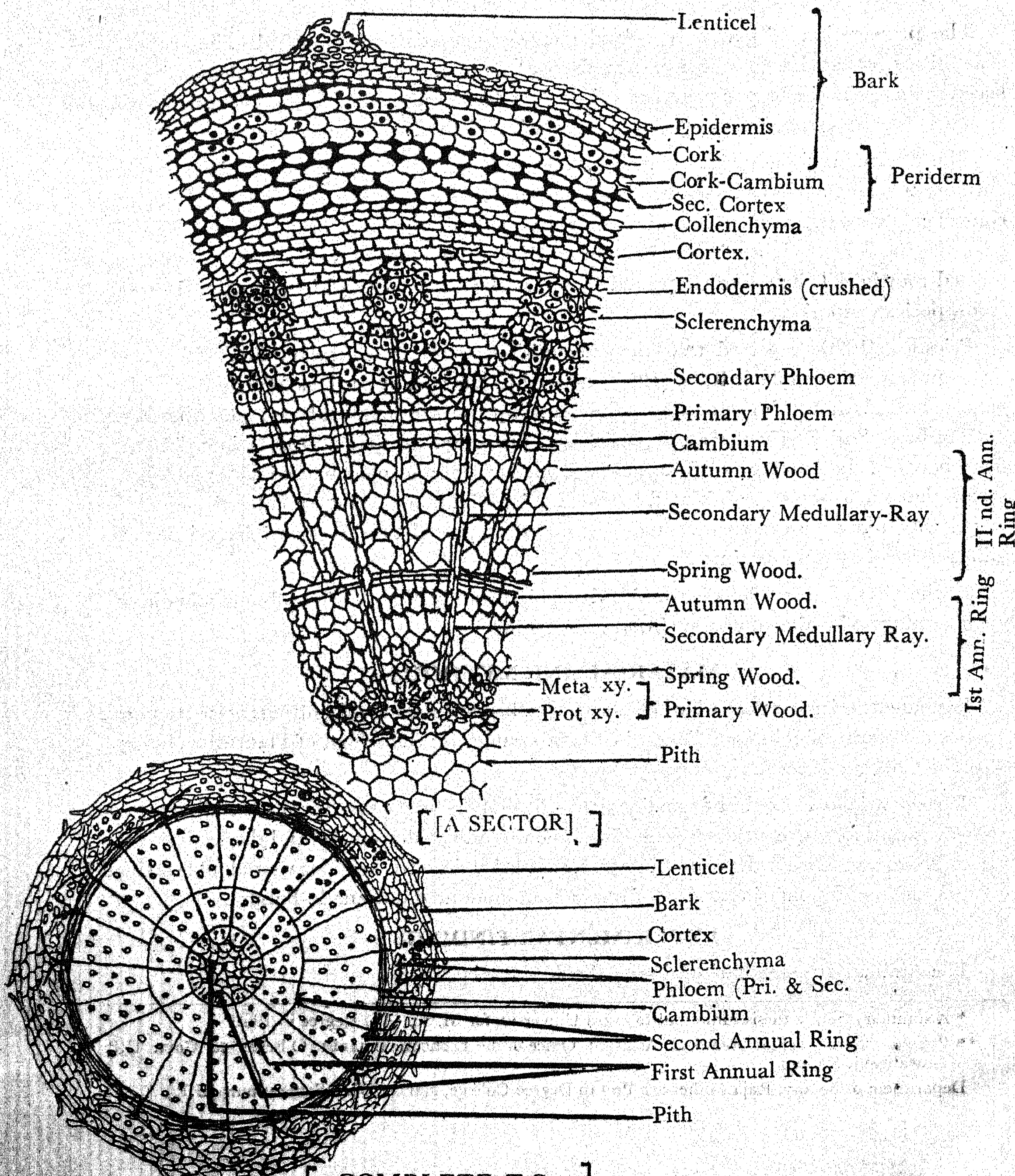
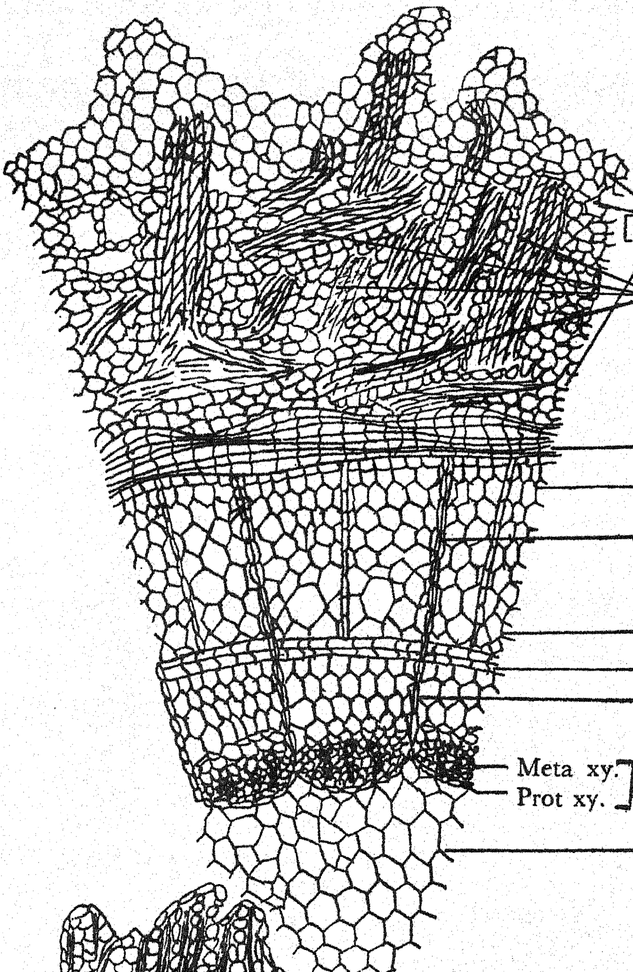
T.S. of a CALLUSING CUTTING



[COMPLETE T.S.]

PLATE 1

T.S. of a CALLUSING CUTTING



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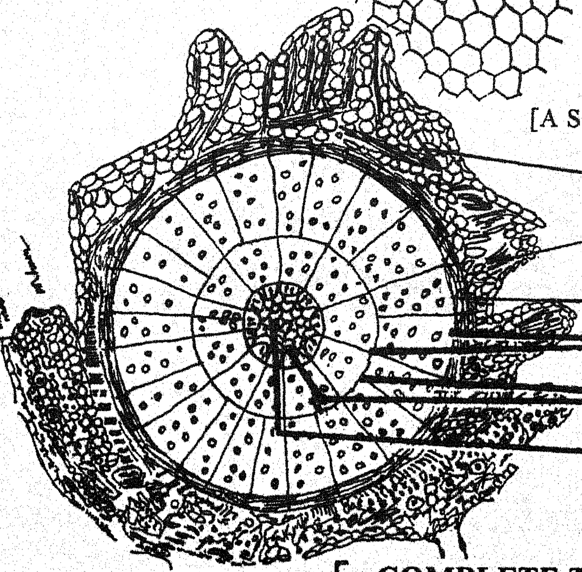

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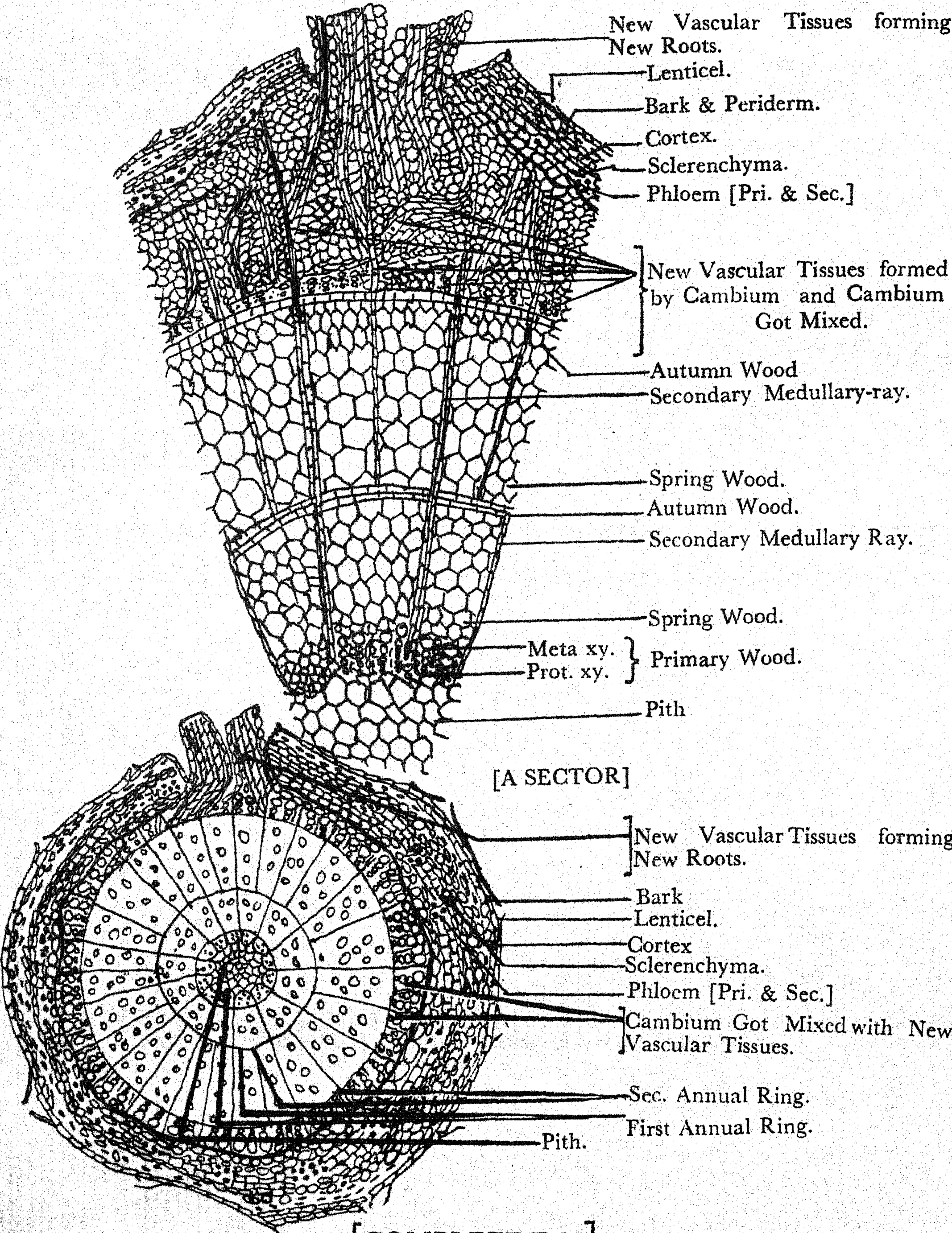
PLATE 2

T.S. of a ROOTED CUTTING



[COMPLETE T.S.]

PLATE 3

TABLE:—1. *A Comparative anatomical study of normal, callusing and rooted cuttings of Morus, Alba* Linn.

Tissues in Secondary Structure.	Normal cutting	Callusing cutting	Rooted cutting
1. Bark:	Present	Absent	Absent.
(*a*) Lenticels ..	Consist of large loose mass of small oval shaped and thin walled cells known as complementary cells.	Rupture and Decay at some places.	Rupture and Decay at some places.
(*b*) Epidermis	Multiseriate; inner and radial walls of epidermal cells are thin, the outer ones are thick and impregnated with cutin known as cutinization.	Ditto ..	Ditto.
(*c*) Cork (Phellem)	3-5 layers of collenchymatous tissues which are dead, long thickened at corners and more or less isodiametris in shape with no intercellular spaces and arranged radially.	Ditto ..	Ditto.
2. Periderm ..	Present	Absent	Absent.
(*a*) Coerk-cambium (Phellogen)	1-3 layers of collenchymatous tissues become active due to the presence of nucleus. These cells are thin walled, long more or less isodiametric in shape with no intercellular spaces and arranged radially.	Rupture and Decay at some places.	Rupture and Decay at some places.
(*b*) Secondary cortex (Phelloderm)	4-6 layers of parenchymatous tissues which are thin walled radially flattened with intercellular spaces.	Ditto ..	Ditto.
(*c*) Endodermis	Secondary growth soon crushes these layers.	Ditto ..	Ditto.
3. Pericyle ..	is represented by semi-luner patches of sclerenchyma and the invening masses of parenchyma. Each patch is double walled and forming the cap of hard bast.	Ditto ..	Ditto.
4. Vascular Tissues;-	Present in ring ..	Present in ring ..	Present in ring.
(*a*) Primary and Secondary phloem.	Consists of sieve tubes, companion cells, phloem parenchyma and patches of phloem fibers.	Phloem parenchyma cells divide quickly by periclinal and anti-clinal division and cover the large area and protect the active cambium ring. It extends horizontally and vertically both.	New phloem parenchymatous cells or phloem ray along with xylem rays develope and are visible in the root primodia.

Tissues in Secondary Structure	Normal Cutting	Callusing cutting	Rooted cutting
(*b*) Cambium ring	Consists of fascicular and interfascicular cambium having 3 layers of radially arranged parenchymatous cells which are rectangular thin walled small in size with active protoplasm. (refer plate-2).	becomes 4-6 layerd and more active and forms callus away from the centre by the production of new vascular tissues over the cut surface (refer plate-3).	Unites with the new vascular tissues which ultimately mix with the old wood by the formation of uni and multicellular xylem rays in root primodia which is thickened double walled and dark stained. Thus wound is completely covered with the callus. (refer plate-4).
(*c*) Secondary sylem:-	2 annual rings present ..	2 annual rings present ..	2 annual rings present
i. Spring wood	Consists of narrow pitted vessels, trachieds and wood fibers which are formed in spring known as early wood.	Same as in normal ..	Same as in normal
ii. Autum wood	Consists of narrow pitted vessels, trachieds and wood fibers which are formed in winter known as late wood.	Ditto ..	Ditto
iii. Sap wood ..	3-4 layers of lighter coloured cells which are thin walled.	Ditto ..	Ditto
iv. Primary wood	Consists of meta and proto xylem, trachieds, wood fibers and wood parenchyma.	Ditto ..	Ditto
5. Medullary Rays.	1-2 stips of parenchymatous cells which are radially elongated and present in between the secondary xylem and secondary phloem.	Ditto ..	Ditto
6. Pith ..	This central cylinder is made up of parenchymatous cells.	Same as in normal ..	Same as in normal
7. Root Primordia.	Not formed	Developed ..	Well developed and grow outward

DISCUSSION:—

It can easily be noted from Table 1, that vascular tissues (Phloem, Xylem and Cambium) play a great role for the initiation of root primordia. The activity of cambium is to produce amorphous mass of parenchymatous tissues known as callus and with an initiation of root

initials which further develop into a normal growing roots known as wound roots or adventitious roots.

A large number of cells are produced as a result of regular activity of cambium by mitosis division which exhert a considerable pressure on cortical cells. The cortical cells and epidermis started rupturing, cracking and finally fall and decay at some places. This fact has been supported by Eames and MacDaniels (1953) who stated that the cortex and endodermis are ruptured and soon decay, so that the roots have a smooth, brownish covering of cork cells broken only by lenticels which in Morus Spp. appear as transversely elongated roughenings of the root surface.

From plate 3 it is noted that the new vascular tissues are formed inside the callus consisting of parenchymatous cells only by the activity of cambium. Esau (1958) reported that cambium tissues produced parenchymatous cells which divide and give rise to new vascular tissues therein.

It is observed from plate 4 that new roots originate from the parenchymatous cells (callus) connected with cambium tissues and these roots further peneterate mechanically through cortex and endodermis and grow outward. The findings of Surti (1950) in mulberry cuttings, Rake (1957) in gooseberries cuttings and Singh *et al.* (1961) in phalsa cuttnigs have also supported this conception.

SUMMARY AND CONCLUSION:—

From the findings of present experiment it is observed that new roots arose endogenously after formation of new vascular tissues in the basal callus from a meristematic cells which is a continuation of the cambium containing parenchymatous cells.

ACKNOWLEDGEMENT:—

I wish to acknowledge with gratitude the generosity of Dr. V. Puri, M.Sc., Ph.D, D.Sc., F. N. I, Professor of Botany, School of Plant Morphology, Meerut College for allowing me to prepare Microtomic slides under the guidance of his Assistant Dr. N. C. Mathur in his laboratory.

I am thankful to Miss M. P. Thomas, Librarian, Allahabad Agricultural Institute for affording me library facilities.

I convey my thanks to Mr. Gauri Shankar, Associate Professor of Horticulture Allahabad Agricultural Institute for his valuable suggestion in the preparation in this note.

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Technical News

MODEL FARM IN KERALA

An Indo-Japanese model agricultural demonstration farm is being set up at Chengamanad, near Alwaye in Kerala. This is one of eight such farms set up as per agreement between the Governments of India and Japan for demonstrating improved agricultural practices, for paddy cultivation. The agreement is for three years.

The Chengamanad farm has been set up on a 23 acre plot out of which 14 acres have been set apart for conducting trials on Japanese method of paddy cultivation. From these will be evolved suitable methods that can be adopted by Indian farmers, to increase the yield per acre to the maximum possible.

The Japanese Government will supply more than rupees two lakhs worth of agricultural machinery and other equipment, four Japanese experts and meet the expenses of cultivation.—"*Arya Swapatra*", Volume II, No. VII, January 1, 1966.

100 ACRE MODEL FARM FOR MAHARASHTRA

Maharashtra's Minister for Agriculture, Mr. P. K. Sawant had a discussion with a Japanese delegation from the Organization for Industrial Scientific and Cultural Advancement which is an international non-profit private organization without any affiliation to racial, political, religious or economic circles of the world. The object of this organization is to assist the developing countries in the field of industrialization in order that they may be able to achieve self-sufficiency.

The proposed model farm for Maharashtra will be a joint Indo-Jap project, Japanese agriculture experts will be provided to help in the management of the farm for a specified period and the expenses will also be covered by the organization. After the farm has been developed, it will be for the Indian authorities to take over the management.—"*Arya Swapatra*"—Farmer's own Bulletin, Vol. II, No. VIII, January 8, 1966.

FOOD GRAINS OUTPUT ESTIMATE

According to the United States Agency for International Development, India's foodgrains output in 1965-66 will amount to between 79 and 81 million tonnes compared with 88.4 million tonnes in 1964-65. During 1964-65 imports totalled 7.4 million tonnes making total availability of 95.8 million tonnes.

Allowing for population increase, the Agency has estimated that for having the same per capita availability in 1965-66 as in 1964-65, there is need for import of 12 to 14 million tonnes of wheat grain under PL 480.

According to the Agency, the short fall in the Kharif crop this year is estimated at about 7 million tonnes from last year's Kharif record output of 59.8 million tonnes—"*Arya Swapatra*"—Farmer's Own Bulletin, Vol. II, No. VIII, January 8, 1966.

CLEAN EGGS

A clean egg may have as many as 100,000 bacteria on the shell; a slightly soiled egg as many as one million; and where stock has been kept on deep litter under damp conditions, badly soiled eggs may carry as many as 90 to 100 million bacteria. How quickly these find their way inside depends to some extent on the quality of the shell, season and other factors, but the big danger is moisture on the shell; You can't count the bacteria simply by looking at the egg, but the figures may help some farmers to take clean shells a little more seriously.—*Arya Swapatra*, Farmer's own bulletin—Volume II, No. IX, January 15, 1966.

FARM IMPLEMENTS DESIGNS COMPETITION

The Indian Council of Agricultural Research has invited entries from individuals, Commercial firms and institutions both in the public and the private sectors, manufacturing agricultural implements for the annual competitions.

Two prizes of the value of Rs.10,000 each in cash or kind with certificates of merit for the best design of seed drill and thresher will be awarded. In other deserving cases, certificates of commendations will also be given.

The intending competitors may obtain the prescribed application forms and the details of the rules governing the competition and the basic specifications for both the machine from the secretary, Indian Council of Agricultural Research, Krish Bhavan, New Delhi.—*Arya Swapatra*, Volume II, No. X, January 22, 1966.

SEED FARM FOR PUNJAB

Two big centrally sponsored seed farms, each of 20,000 acres will be set up in Punjab in the public sector, to supply high quality seeds to farmers. These seed farms are being set up by the State Government with the assistance of experts from the Central Government.—*Arya Swapatra*, Volume II No. X, January 22, 1966.

THREE CONDITIONS FOR HIGH RICE YIELDS

By E. VELICHKO*

Many years of work in the sphere of rice growing have helped me to draw a number of generalised conclusions regarding the main conditions on which high rice yields depend. In our opinion, there are three such conditions, which can be formulated briefly as follows: oxygen, albumin, and levelling of fields.

This of course does not mean that other factors on which rice harvests depend do not play an important role here. It is essential, for instance, to have good seeds, prepare the soil thoroughly, carry out the planting in time and on a high level, protect the crop from diseases and pests, etc. But all these and many other requirements refer in equal measure

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to all agricultural crops, whereas in this article, we shall discuss only those which are specific for rice.

OXYGEN REGIME

We know that a plant cannot exist without oxygen. Rice, however, grows on flooded soils in which there is no free oxygne. This ability is explained by the fact that an air cell layer (aerenchima) is formed in the blades and stems of the plant, along which oxygen of the air is supplied to all its parts, including the roots—if they are unable to receive it from the flooded soil.

However, this does not mean that rice reacts indifferently to the presence or absence of oxygen in the soil. As a matter of fact, the air cell layer in the rice roots does not form immediately. At first the small root of a sprouting rice seed does not differ in its anatomic structure from the roots of wheat, barley and other dry cereal plants. It has root hairs on its surface and no air cell layer.

The soil might contain compounds such as hydrogen sulfide, butyric acid and cyanic compounds, which are poisonous for rice. In order to overcome the toxic influence of these substances, the rice plant not only supplies oxygen in the roots, but also secretes it from the roots in the soil. As a result, an oxidised zone is formed around each root, in which the poisonous substances are destroyed by the oxygen secreted from the roots.

However, in order to give the rice plant the ability to display an active influence on the soil, it is necessary for the young root to shed its coating, together with the hairs. Otherwise the oxygen from the inner cavity of the root is not secreted in the soil. Such reconstruction of the roots' anatomic structure also requires a certain amount of time.

Thus, in their early period of growth, the fate of the young rice plants depends on whether there is oxygen in the soil. If its supplies are sufficient for that period, the plants will survive, if not, they will perish. In other words, the number of vital and fruit-producing plants remaining on the field depends on the oxygen supplies in the soil at the moment when the rice was planted.

MAXIMUM OXIDISED CONDITION

Every rice-grower—if he wants to produce a bumper crop—must strive for a maximum oxidised condition of the soil at planting time. In order to achieve this it is necessary to have a good functioning drainage system, carry out the immediate ploughing of fields after harvesting, and cultivate the dry soil intensively before planting. This aim is also facilitated by all measures employed in improving the soil structure, and also by alternating the rice plantings with other dry crops. It can be assumed that sooner or later, alongside with nitrogenous and phosphorous fertilisers, we shall also be applying oxygen fertilisers. At any rate, we already have fully tested and available methods at our disposal for improving the oxygen regime on the soil of rice fields.

Among the elements of mineral nutrition, a highly-important place for rice is held by nitrogen. This does not mean that phosphorus and potassium are not required by rice, but the supply of these two elements is always more favourable in flooded soil.

Nitrogen in mineral fertilisers is contained in two forms: oxidised (nitrates) and deoxidized (ammoniac or amidic). The nitrate form of nitrogenous fertilisers (various saltpetres) are unfit for rice. The thing is that when nitrates are flooded, the anaeorbic micro-organisms are destroyed quickly, and washed from the soil. Ammoniacal nitrogen, when flooded, is, on the contrary, stable and can be fully assimilated by the plants. It is, therefore, better to fertilise rice fields with ammonium sulphate or ures.

Ammoniac nitrogenous fertilisers, however, also have a serious shortcoming. Ammonium sulphate is assimilated very quickly not only by the rice plants, but also by the weeds—algae. As a result, the rice plantings begin to feel a nitrogen shortage, and this necessitates an additional application in the form of top dressing.

ROTATION OF PLANTING

It is a different matter if the soil, at the time of planting, is well manured with fresh organic fertiliser, possessing a high albumin content. Under these conditions, the secretion of ammonia takes place gradually and not on the soil's surface, but in the root zone. Bean cultures are rich in albumin. The rotation of their plantings with that of rice is, therefore, one of the most effective methods of receiving high rice yields. Morever, the farm can free itself completely from the purchase of mineral nitrogenous fertilisers.

Besides, bean crops improve the soil structure, facilitate its aeration and, consequently, also the destruction of poisonous products. They also provide the farm with feed for its livestock and valuable grain.

The following pulses are planted in the USSR as companion crops of rice—lucerne, clover, wintering peas, winter and spring vetch, and soya in some of the areas. Suitable corps can always be selected for this purpose in any country, with any climatic conditions.

Big rice yields can be obtained only on very evenly-flooded fields. With this aim in view, the fields are subjected to careful levelling. When the rice-irrigation systems are constructed such work is carried out in the Soviet Union with the aid of machines.

Later, every 2-4 years, the fields undergo thorough levelling, and are evened with simple implements before each planting. Only under these conditions can the rice grower feel confident about the fate of harvest.

What practical conclusions follow from the above-mentioned facts?

Only one conclusion can be drawn here: it is necessary to grow rice in a proper crop-rotation system. The seven-field system is considered best on the flooded land of the Kuban. The first and second fields are planted with perennial grasses, the next two with rice, the fifth is under fallow, and sixth and seventh with rice. Under this scheme, the share of rice plantings is 57 per cent. Thus, proper crop rotation guarantees high and stable harvests with minimum expenditure of labour and means.—*Soviet Features* Vol. IV, No. 68, March 29, 1966.

NEW DEVICE TO MEASURE BUTTER CONTENT IN MILK

SERGEY KUZHELNY

The need for a quick and exact method of establishing the butter content of milk has long been felt in farming. The old method takes from 15 to 20 minutes and is not accurate. To take one analysis about 10 cubic centimetres of sulphuric acid and one cubic centimetre of isoamyl alcohol are required. Since the number of analyses made annually runs into scores of millions large quantities of chemical reagents are used.

Exact figures of the butter content in milk are needed for calculating feed rations, keeping records of milk production and properly organizing remuneration of the work of dairy farmers. In pedigree breeding this index is a necessary condition for developing improved cattle breeds.

Butter has no characteristic physical properties distinguishing it from other milk products. The scientists of the biophysics and isotopes laboratory of the Byelorussian Academy of Sciences have made an attempt at giving it a new, artificial physical property. Their research was founded on the principle of ultraviolet luminescence.

A dyeing substance having the necessary properties was produced at the Moscow Institute of Chemical Reagents and Highly Pure Substances. A solution of the substance is added to the milk together with a little alkali and the mixture is boiled for three minutes. This is sufficient to give the milk an even yellowish-green luminescence. Its intensity is an exact indication of the butter content of the milk.

A laboratory model of the fluorescent butter-meter, designed by the Byelorussian scientists, measures the butter content in three and a half minutes to within 0.05—0.07 of 1 per cent.

The new device can also be used to establish the oil content in the selection of oil bearing plants, the manufacture of glue and artificial fibre, etc.

Nevesti Press Agency (APN) MXI 3397-B-65

A thesis from Aberdeen University on the Utilization of Dietary Nitrogen by Early-Weaned Calves has recently been microphotographed and republished in microfiche form.

The thesis presents information on the relative merits of different protein concentrates in promoting nitrogen retention in young calves which have been weaned from liquid food at three weeks of age. In particular, interest is centred in the relative importance of protein solubility and amino-acid composition as factors influencing protein utilization. The relationship between rumen-ammonia and blood-urea concentration is also investigated, as is the effect of dietary antibiotics on protein utilization.

Details of this and other theses bearing on agricultural matters, which have been microphotographed and thus made more readily accessible to other workers in the same field, are available from Micro Methods Limited, East Ardsley, Wakefield, Yorkshire.—Micro Methods Limited, East Ardsley, Wakefield, Yorkshire. *Telephone* Lofthouse Gate 3251 (3 lines).

The Journal of the Royal Agricultural Society of England (volumes 122-124 covering the years 1961—1963), has been microphotographed and republished as three reels of microfilm.

This has been done in order to make its contents more readily accessible to agricultural research workers. Full details from the Publishers of the micro edition, *Micro Methods Limited, East Ardsley, Wakefield, Yorkshire.*

FERTILIZER INDUSTRY AGAIN SUPPORTS FAO PROGRAMME

Rome, 26 January—The world fertilizer industry today pledged support for the forthcoming sixth year of FAO's fertilizer programme, being carried out under the Freedom-from-Hunger Campaign. The programme has conducted more than 65,000 trials and demonstrations over the past five years.

The world industry, represented by the FAO fertilizer industry advisory panel, agreed to renew its annual donation of $300,000 together with 900 tons of fertilizer. The panel gave assurance that it would continue supporting the programme for at least another two years.

The panel also said it welcomed support offered to the programme by various fertilizer-exporting countries, and hoped this additional aid would lead to extension of the programme into Asia, particularly to India. At a meeting the representative of the United Kingdom had offered £40,000 ($112,000) worth of British fertilizers to the programme. The representative of the Federal Republic of Germany offered continued support in cash and kind to pilot fertilizer credit and distribution schemes being carried out in Turkey and Nigeria. Last year the Federal Republic of Germany contributed fertilizers, experts and vehicles to the total value of $180,000 to the programme.

Additional offers of three fertilizer experts were made by the representatives of Canada and Denmark to help carry out the programme in 18 countries in the Near Eeast and North Africa, West Africa and Central Latin America, were also announced. Eleven experts now are being provided to the programme by Belgium, the Federal Republic of Germany, Italy, Netherlands and Norway.

The panel urged the removal of all restrictions on imports of fertilizers into developing countries. It also recommended that FAO contribute more of its own funds to the following year's programme, and that FAO and the industry together seek the support of other interested organizations. FAO last year contributed $83,500.

The panel expressed the hope that FAO would take advantage of an offer from the Government of Israel to sponsor summer training courses for technicians.

A suggestion for a "world production requisite pool",through which developing countries could get such essentials as pesticides and fertilizer on a long-term-loan basis at nominal interest, was made by the panel chairman, Mr. J. M. Boudewijn (Netherlands). This was one of a series of points made in his opening statement on the future shape of the programme. I/R/Press 66/21 LW/83, *Food and Agriculture Organization of the United Nations, Rome.*

WORLD FERTILIZER PRODUCTION RISES SHARPLY

Rome, 26 January—A rise of more than 10 per cent. in world fertilizer production was achieved for 1964-65 over the previous year's figure according to preliminary estimates released today by the FAO Fertilizer Industry Advisor Panel following a meeting of its newly-established committee on statistics.

The committee, consisting of experts from FAO and the world fertilizer industry, had completed a review of world production and consumption statistics, and announced arrangements for closer future co-operation between FAO and the industry in collecting and disseminating such statistical information.

The estimates put the combined world output (excluding mainland China) of fertilizer nitrogen, processed phosphoric acid and potash in 1964/65 at slightly over 42 million tons, 10.9 per cent. more than in 1963/64. While output of potash (12 million tons) and that of nitrogen (16.47 million tons) increased by 11 per cent, output of processed phosphoric acid (13.68 million tons) rose by 10 per cent.

During the fertilizer year under review, the largest estimated increase in output was shown by Europe (1.5 million tons), followed by the Union of Soviet Socialist Republics (U. S. S. R.) (1.1 million tons) and North and Central America (940,000 tons). Asia also showed a sharp increase of about 400,000 tons.

World consumption of all fertilizers (excluding mainland China) totalled nearly 40.5 million tons, an increase of 11.5 per cent. over 1963-64. This figure excludes ground rock phosphate for direct application.

The heaviest rate of application was still found in Europe, with a consumption of some 110 kg. of all fertilizers per hectare of arable land. This compared with 45 kg. in North and Central America, 39 kg. in Oceania, 22 kg. in the U.S.S.R., 11 kg. in South America and Asia and only four kg. in Africa. I/R/Press/66/22 LW/84, *Food and Agriculture Organization of the United Nations, Rome.*

ISRAEL: UTILIZATION OF SEWAGE WATER FOR IRRIGATION

Millions of cubic meters of purified sewage water a year, currently being channelled into the sea because of its high salt content, can be made usable for agriculture, claims Technion Sanitary Engineer Menahem Rebhun.

Reclamation of sewage has long been an intergral part of Israel's Water Master Plan—biological treatment, sand filtration, chlorine disinfection, and other methods rid the sewage of pathogenic organisms and unstable organic materials. "However, mineral salts are not affected by these processes and will pass through the treatment plants practically unchallenged," states Mr. Rebhun. In sufficniet quantities this salt makes the water unusable for agriculture, and there remains no other course but to dispose of it in the sea.

Utilizing the Haifa system of sewage treatment for his study, Mr. Rebhun pinpointed the introduction of salt into the sewage as emanating basically from two sources, from industrial plants and from certain types of water softeners.

"By merely separating the saline industrial wastes and spent brines (salt solutions) of softening installations from the municipal sewage system and by modifying the softening processes, up to 10 million cubic meters of water (353 million cu. ft.) annually in the Haifa area alone can be saved for agricultural use. This figure for reclaimed water could reach as high as 100 million cubic meters for the entire country" says Mr. Rebhun.

Investigative studies carried out by Tahal (Water Planning for Israle Ltd.) confirm Mr. Rebhun's findings, and Tahal is now planning to implement the suggestion to re-channel the sources of high salt content out of the main sewage systems. Ref. 260.2-24 February 1966.

CONSULATE OF ISRAEL,
50 Pedder Road
Cumballa Hill Bombay, 26.

HEBREW UNIVERSITY BIOLOGISTS HELP TO SOLVE SUGAR BEET PROBLEM

Professor Gad Avigad and his associates in the Biological Chemistry Department of the Hebrew University have made an important contribution to the solution of a problem that troubles sugar beet growers all over the world. It is well known in sugar technology that there is a loss of sugar through respiration from the time the beet is pulled up in the field until it reaches the crushers in the factory. Since one-third of the sugar of the world comes from beets and the remainder from cane, this loss may reach considerable proportions. But the problem is not as acute in cold European countries as it is in Israel. with its subtropical climate.

Most scientific investigations have been directed to the effect of various external physical conditions and chemical inhibitors on respiration. Until recently, however, very little work had been done on the biochemical basis of the building up and breaking down of sucrose in the sugar beet root. These changes are brought about by enzymes, organic substances in the cells which accelerate chemical changes. A study of the patterns of enzymes and of the pool of chemicals involved in this process of sucrose metabolism has been made by Prof. Avigad and his colleagues with the aid of a research grant from the U. S. Department of Agriculture.

"We have now made a very detailed survey of the pool of metabolites in the tissue which are concerned with sucrose metabolism," says Prof. Avigad. "We have also characterised and identified more than fifty enzymes which are found in the tissue and are part of the various metabolic pathways of carbohydrate metabolism. We have devoted much time in particular to the first step, which brings about sucrose degradation."

Until they began their work it was classically accepted that the enzyme known as invertase was responsible for starting off the sugar breakdown, while another, called "sucrose synthetase" was a key enzyme in the building up of sucrose. Prof. Avigad and his team found that whereas the sugar beet root was loaded with sucrose synthetase, invertase was practically non-existent. This was mysterious—how was the sucrose broken down if the invertase was not present?

"We devised several new and improved methods, using spectrophotometry, chromatography and radio-isotope procedures, for detection and identification of the enzyme sucrose synthetase and for its detailed qualitative analysis, "recalls Prof. Avigad. "In the process we isolated sucrose synthetase in a pure form for the first time, so as to study its properties in detail."

By studying the purified sucrose synthetase the scientists were able to show that it was responsible for the slow degradation of sucrose, thus supplying carbohydrates for the energy and assimilatory needs of the tissue, according to its physiological state. It was all the more interesting because the same enzyme when it occurs in the leaves and green parts of the plant catalyses the reaction in exactly the opposite direction, i.e. it can cause the synthesis of sucrose. "We have now gone one step further in our study of the products of action catalysed by sucrose synthetase. This is mainly involved with the further utilization of complex molecules from the nucleotide-sugar group," says Prof. Avigad. Ref. 260.2, 1 March, 1966.

CONSULATE OF ISRAEL,
50, Pedder Road, Cumballa Hill, Bombay, 26.

PREVENTING SPREAD OF PLANT DISEASES

Co-operative Programmes Of Quarantine Suggested

LONDON: Emerging countries would be well advised to work out co-operative programmes of quarantine, says a writer in the current issue of *Pans* (Pest Articles and News Summaries), discussing the problem of the possible spread of plant diseases through increased air travel.

In an article headed "Quarantine: A Price for Freedom," he discusses the problems arising from the proliferation of air fields into the heart of "virgin" country. Airports present problems somewhat different from seaports, one being that since the airport is usually in the interior of the country, the pathogen may sooner reach a new host in the immediate environment.

There is sufficient evidence, the article says, to show that quarantine works, "one example being that East Africa is still free of tobacco blue mould."

Problem of Enforcement

The situation, however, is not adequately dealt with by the regularization of quarantine laws. There remains the problem of enforcement. The introduction of a pathogen may inflict a 10 per cent. loss of a crop's yield.

Customs authorities should therefore not only be given a sheet of instructions, but their training should take some measure of the responsibility that is encompassed by quarantine. Citizens returning home should at some stage be made to recognize their responsibility in co-operating in regular quarantine.

"In quarantine, as in other anxieties, vigilance is the price of freedom," the article concludes.

Research on Contamination

A paper in the same edition of *Pans* deals with the prevention of mould on groundnuts which is harmful to animals and drastically reduces the value of the nuts and groundnut cake derived from them.

The writer, D. G. Bushnell, of the chemistry branch of Rhodesia's Department of Research and Specialist Services, says that evidence suggests that in Rhodesia contamination probably occurs mainly after harvesting.

It is only when the moisture content of the kernels has been reduced below 9 per cent. under cool conditions that the possibility of contamination is reduced to a minimum. If the drying process in the field is interrupted by storms or showers, or if high temperatures or exposure of the pods to idrect sunlight raise the humidity and temperature inside the pod, mould growth may be encouraged, especially if there has been damage to the pod.

Reducing Moisture Content:

The whole harvesting operation should be tailored to achieve a reduction in the moisture content of the nuts as rapidly as possible but without undue exposure of the nuts to rain or direct sunlight, and to keep physical damage to the nuts at the lowest possible level.

Mr. Bushnell advocates lifting the nuts when about 70 per cent. show brownish-black markings on the lining of the pods and the kernels are plump, firm and well-coloured. He says that the operation should be carried out as far as possible when the soil is fairly dry and the plants free from dew·

He recommends constructing cocks of the plants—after being allowed to wilt slightly—on tripods or poles, with the nuts on the inside so that they are protected from sun and rain by the haulm, and possibly adding a protective covering of plastic, sacking, or grass.

The pods should be picked when the moisture content of the nuts is reduced to between 10 and 15 per cent. which will be when the kernels rattle inside the pod and the haulm is dry and brittle. At this stage, it will be possible to pull the nuts from the plant without any damage to the pod.

The pods should then be bagged and stacked in a cool,dry place to allow the kernels to dry out to a moisture content of 6 to 7 per cent. before shelling.—British Information Service, B. 1013.

NEW LIQUID FOOD AS SUBSTITUTE FOR MILK

Vegetarian Congress Given Details

Delegates from 16 countries, including India, attending the 18th world congress of the International Vegetarian Union at Swanwick, Derbyshire, U. K.—on September 2nd, 1965 were told of a new liquid food which is regarded as an excellent commercial substitute for milk.

Called "plantmilk", it has a soya base and is made exclusively from vegetables and vegetable waste. It has been invented by Dr. H. B. Franklin, a chemist. A company has been established to market the product.

Delegates were told of plantmilk by Dr. Alan Stoddard, a medical practitioner and chairman of the company. He said that the product not only was of great benefit to vegetarians but had a great potential in countries with no dairy produce.

Greadt Demand

Plantmilk, he said, was twice as strong as ordinary milk and could be kept up to a week in a cool place. It looks like cow's milk. Although the new product has been marketed only for a few weeks, Dr. Stoddard said that demand was outstripping production.

Advantage of Vegetarianism

At the congress—which is held in a different country every two years—delegates discussed the possible advantages of vegetarianism in developing countries. One speaker said that it would be particularly beneficial to them, as for every ton of beef produced 10 to 12 tons of highly nutritious food could be grown.

The delegates decided that the next congress should be held in India in November 1967—British Information Service.—B 1029.

LONDON CONFERENCE WILL DISCUSS WORLD GRAIN SUPPLY

Meeting of Agricultural Producers' Federation

LONDON—Problems posed by diminishing world stocks of grain were discussed by delegates from more than 20 countries, including India, who met in London in may for the 15th general conference of the International Federation of Agricultural Producers.

The British Prime Minister, Mr. Harold Wilson, officially opened the conference.

The Secretary-General of the Federation, M. Roger Savary, said in London that stocks of grain were now hardly sufficient to meet requirements. The world could be faced with a difficult situation.

Three Main Sections

The two-week conference was divided into three main sections:

(1) An opening plenary session to examine world supplies of foodstuffs generally.

(2) A section to look at trends in national farm policies, particularly in the developing countries.

(3) A section on international policies for agriculture, including tariff agreements and related topics.—British Information Services. B. 534.

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Suggestion for Contributors to The Allahabad Farmer

Manuscripts dealing with all aspects of agriculture and rural life, eductional or research, are accepted for publication in *The Allahabad Farmer*. Manuscripts should ordinarily have more than purely local interest. Articles must be original material previously unpublished elsewhere. After review, each manuscript will be accepted for publication upon recommendation of the Managing Committee.

Manuscript. Two copies, one on bond paper, should be furnished for each manuscript. Double space everything—text, title, footnotes, literature cited, captions and tables (except in long tables). This is to provide space for clear marking for the printer. Number all pages consecutively. An additional copy of the manuscript should be retained by the author to ensure against loss.

Use as short a title as practical. Following the title give the author's name(s). It is desirable to divide the manuscript into sections with such headings as Methods and Materials, Results, Discussion, Summary, and Literature Cited. The order of items in the manuscript should be 1. Title and Author; 2. Text; 3. Summary; 4. Acknowledgment; 5. Literature Cited; 6. Tables; 7. Captions for figures; and 8. Figures.

Avoid underscoring headings, words or phrases unless they are to be printed in italics. Do not use solid capitals for titles. Measurements such as time, weight, and degrees should be in Arabic numerals regardless of the number of digits in the number. Where the figure is not one of measurement, figures below 10 should be spelled out except when one figure in a series has two digits, in which case all should be in Arabic. Scientific names of plants, chemicals, etc. or descriptions thereof should be given the first time used. Nomenclature, abbreviations, and definitions should follow standard references and those generally accepted for the purpose.

Footnotes. The title and address of the author(s) should be given as footnotes. Number footnotes to the text consecutively throughout the manuscript with superscript Arabic numerals. Designate footnotes to tables with superscript lower case letters.

Figures. Experimental data may be presented in graphic and tabular form, but the same data will not be presented in both forms. Photographs should be clear glossy prints and should be trimmed of unessential portions. Never use clips on photographs in any way. Graphs and drawings should be inked with heavy black lines to ensure clarity after reduction in size. Hand lettering should be large and clearly made preferably with a lettering guide; typing is not acceptable. Place the author's name on the back of each figure submitted. Type the legends for all figures on one sheet separate from the figures, in double space. Figures should be numbered consecutively in Arabic numerals.

Tables. Type each table double-spaced on a separate sheet. In long tables, the lines may be single-spaced, but the headings must be double spaced. Tables should be numbered consecutively in Arabic numerals in order of reference in the text. In tables, the caption, column headings, and side heading should be in lower case with only the first word and proper names capitalized. Avoid reporting non-significant decimal places in data.

Literature Cited. Citations are numbered alphabetically by senior author; the number of the reference is used in the text. Citations should include names of all authors, year of publication, complete title, publication, volume number, and inclusive pages, in that order. When there are two or more authors, put initials after the name of the first and before the name of others.

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Influence of Source on the Performance of Soft-Wood of Guava (*Psidium guajava* Linn)[1]

MAN SINGH MANOHAR[2]

INTRODUCTION

The guava which is one of the most important fruits of this country is still almost exclusively propagated from seed. Considerable variation is noticed in the performance of trees grown from seedlings and therefore some vegetative method must be used to multiply the desirable varieties. Hayes (1953) and Du Preez (1954) recommended layering, inarching, root cuttings and hardwood cuttings or suckers to be tried for the propagation of guava. Teaotia and Asthana (1960) and Shrivasthava (1962) have reported that the guava could be successfully propagated through budding. Of all the methods, that by cuttings is the most important and it is on this method that nurserymen and gardners chiefly rely.

Since hardwood and semi-hardwood cuttings of guava are not successful, an attempt was made to find out the possibilities of its propagation by softwood cuttings. Recent work on propagation by cuttings has shown that there is direct relationship between the vigour of plant shoots and the rooting of cuttings taken from them. Since in guava water sprouts and root suckers are very much common and are much more vigorous as compared to normal shoots and since the trees can also be invigorated to varying degrees by pruning, a trial was conducted to investigate the influence of source on the performance of softwood cuttings.

METHODS AND MATERIALS

The experiment was conducted in pots during rainy season of 1960 at B. R. College, Bichpuri, Agra. The pots were kept in polythene covers under partial shade of lath house. Polythene covers of 125 cm X 75 cm X 50 cm size were prepared. Four sides and the top, leaving the one to face the ground of each wooden frame were filled up to the brim with a mixture of sand and sieved leaf mould in the ratio of 1:2 by volume.

A two-factor experiment with five sources of cuttings and three plant regulator concentrations (IBA) was conducted in randomized block design. Since the effect of plant regulator

1. This investigation formed a part of an M.Sc. thesis in the Agra University.
2. Present address: Central Arid Zone Research Institute, Jodhpur (Rajasthan).

concentration was not very clear, this part of work has not been presented here. Each of the five source of cuttings were replicated four times and each of the plot unit consisted a row of fifteen pots, ten for final observations and five for periodical study. The softwood cuttings of about 10 cm length were obtained from five different sources i.e. from normal shoots, water sprouts, root suckers, forced sprouts and cuttings. The cuttings from first three sources were taken from healthy seven years old trees of the college orchard. Forced sprouts were obtained by dehorning twigs of less than 3cm diameter of a seven year old healthy tree from the same orchard, seven weeks before (30th May 1960) planting of cuttings. Cuttings were the plants produced by softwood cuttings in the previous year. The bottom pair of each cutting was removed (to facilitate planting) and were planted 2.5 cm deep with the help of a planting sword.

The cuttings were frequently watered by a watering can of fine rose. The interval of watering was long when humidity was high and temperature was low, generally seven to eight light waterings were done on such days. No watering was done in the night. Lifting of polythene covers for frequent watering helped in removal of warm water vapours on hot and sunny days from polythene covers, as the temperature inside the cover used to become very high under such conditions. In the third week after planting, the cuttings were found to be infected with stem borer (*Microcolona leucasticta*). The pest was controlled through petrol fumigation daily for a week in each polythene cover. A second attack, milder in intensity, was noticed on 21st August, 1960 as a result of eggs layed by the pest during the first attack and the same control measures were followed.

Out of the fifteen cuttings in each plot, five were utilized for periodical study and the remaining ten for final study. Periodical observations were made at fortnightly intervals from planting till final recording done at twelve weeks after planting. Various root and shoot characters were recorded while making observation and are reported below.

RESULTS

The results are presented in Fig. 1, 2, 3 and 4.

Fig. 1 presents the rate of survival. It would be seen that the first six weeks were very important, since the death of cuttings occurred generally during this period and later on the death rate became very slow in all the sources. Cutting shoots proved to be the best source from the very bginning and it maintained its superiority till the end. In the remaining sources there was some fluctuation during the first six weeks but after this the order of survival became established and the same continued till the end.

Fig. 2 shows the percentage of cuttings rooted at the end of the experiment. The highest percentage of cuttings rooted i.e. 38.3% was recorded in cuttings taken from cutting shoots. Cuttings from root suckers were next best with 20% rooting whereas those from water sprouts and forced sprouts gave 10.8% and 6.7% rooting, respectively.

Fig. 3 depicts the effect of source of cuttings on the number of roots per rooted cutting. Since there was no rooting at all in cuttings taken from normal shoots, the data were not subjected to statistical test for this would not have represented the correct rooting performance of the rooted cuttings. The capacity of the cuttings to form roots when taken from root suckers was far superior to those from other sources. The capacity of rooting was second,

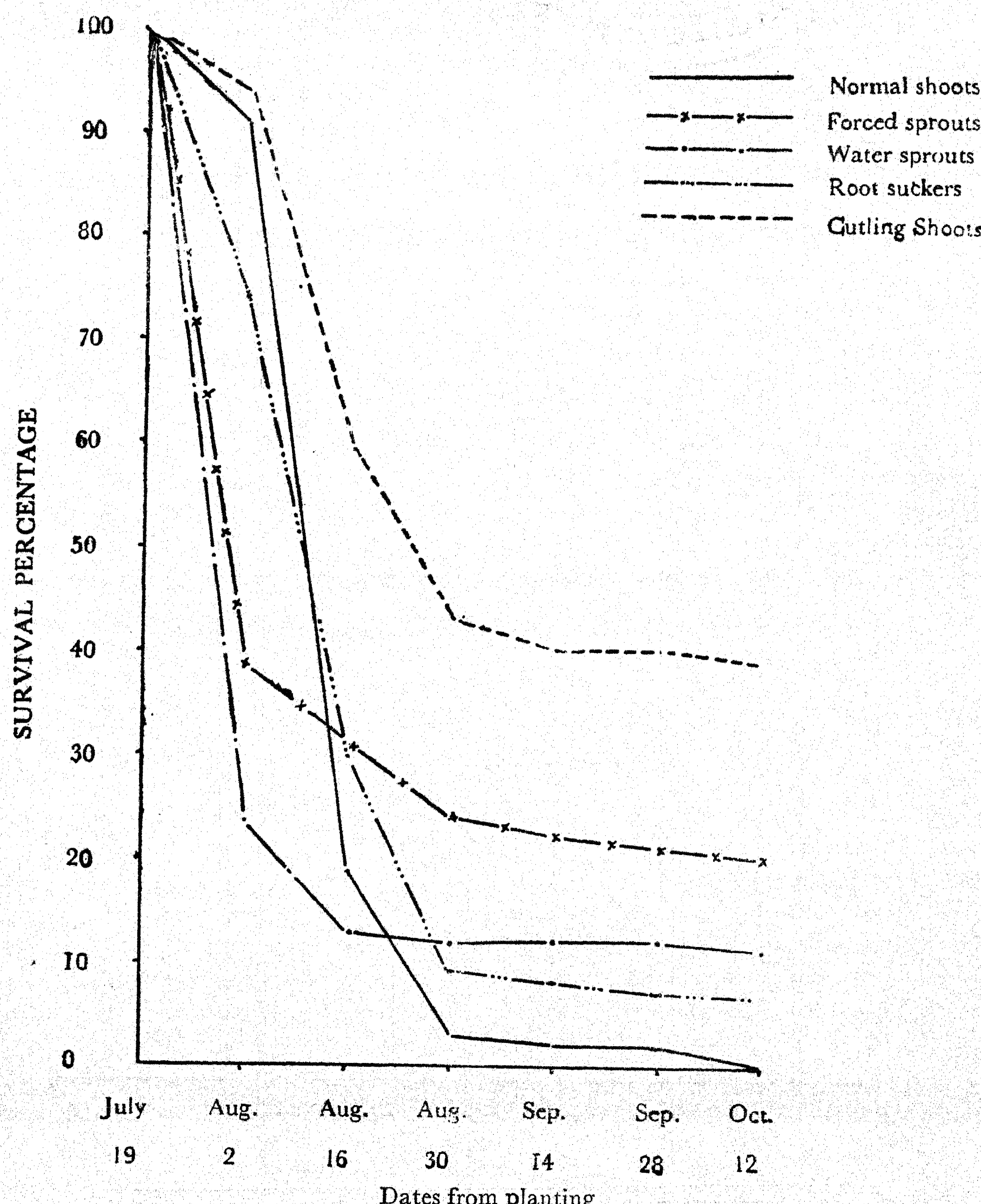

Fig. 1. Effect of source on percentage of cuttings survived

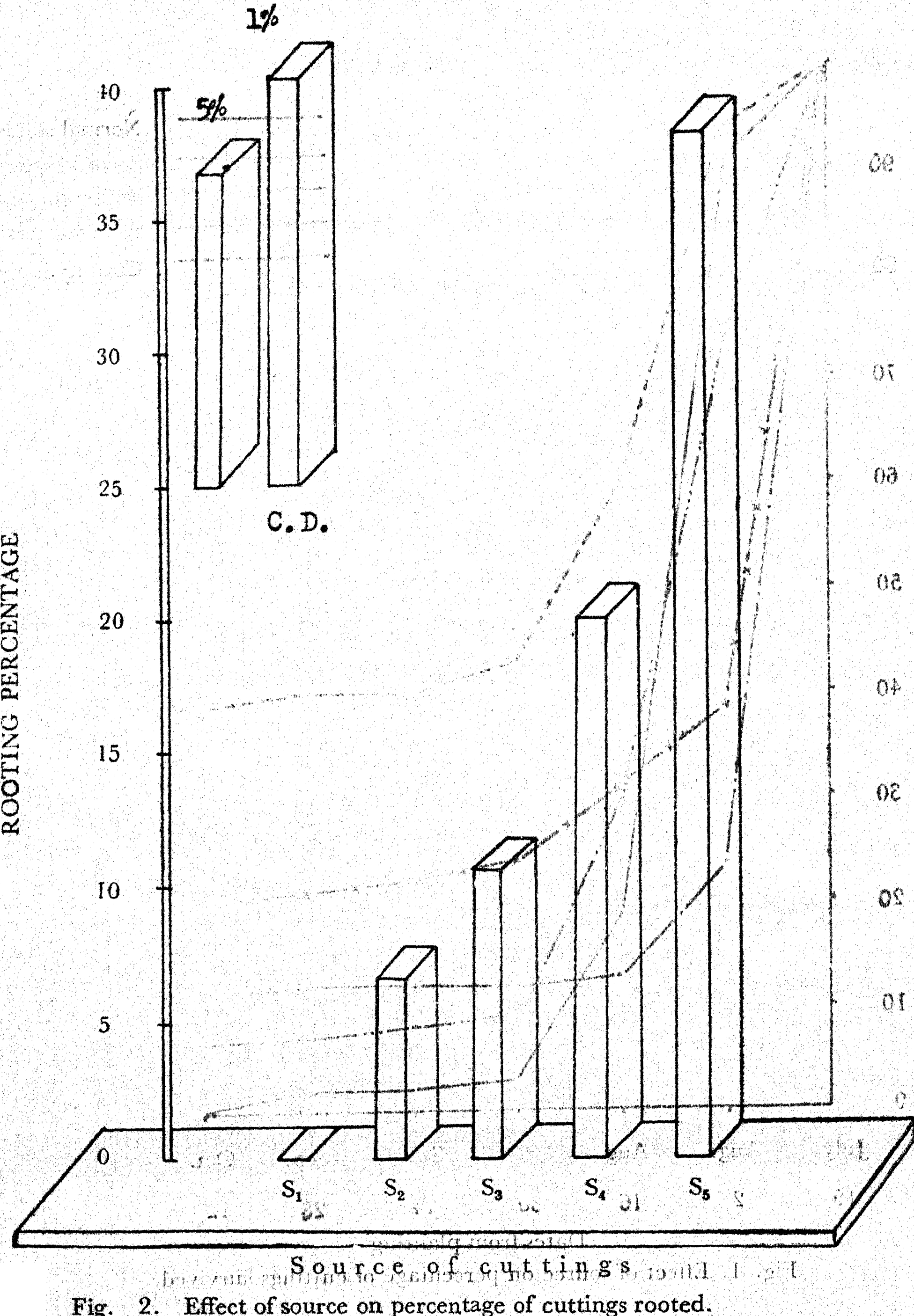

Fig. 2. Effect of source on percentage of cuttings rooted.
S_1—Normal shoots; S_2—Forced sprouts; S_3—Water sprouts
S_4—Root suckers; S_5—Cutling shoots

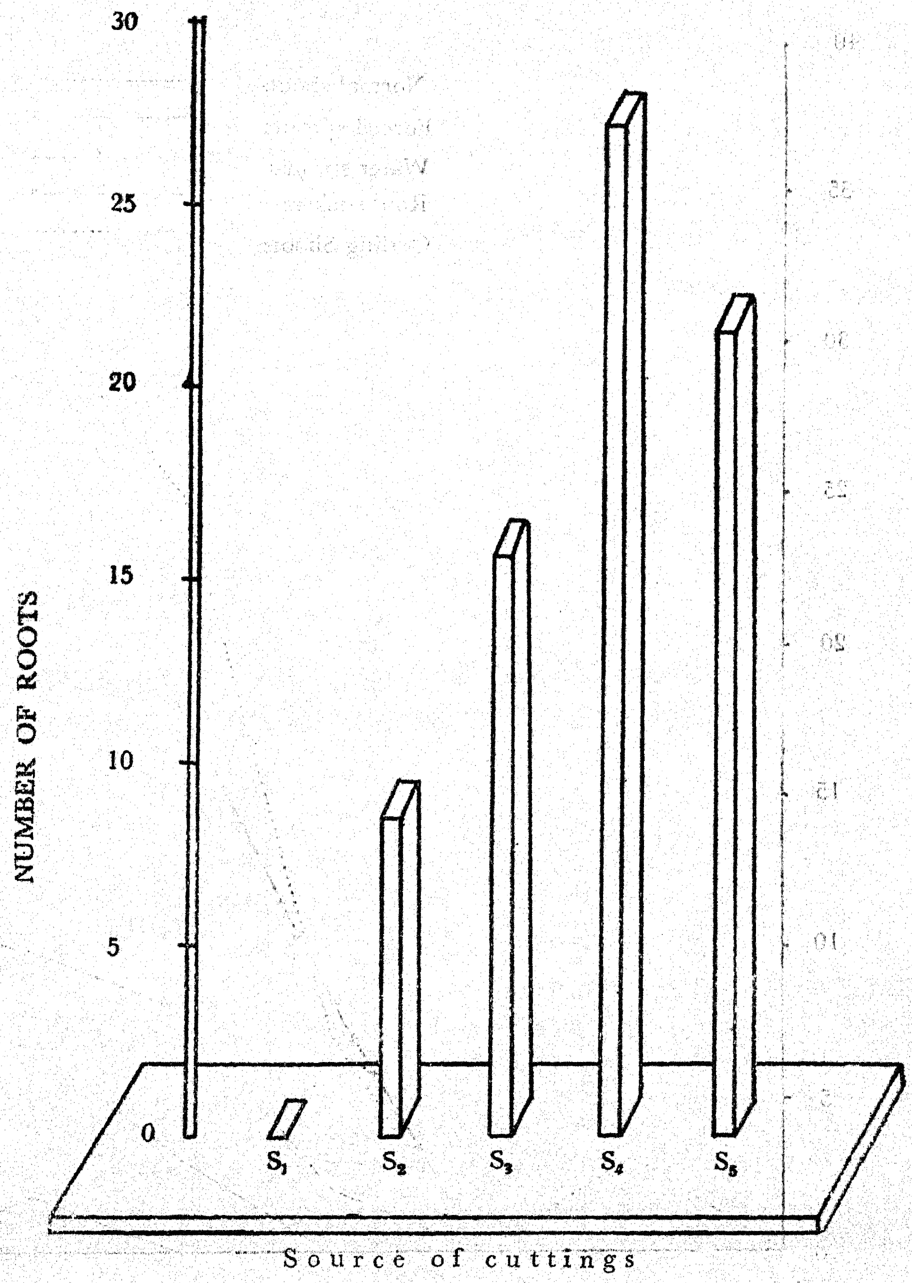

Fig. 3. Effect of source on number of roots
S_1—Normal shoots; S_2—Forced sprouts; S_3—Water sprouts
S_4—Root suckers; S_5—Cutling shoots

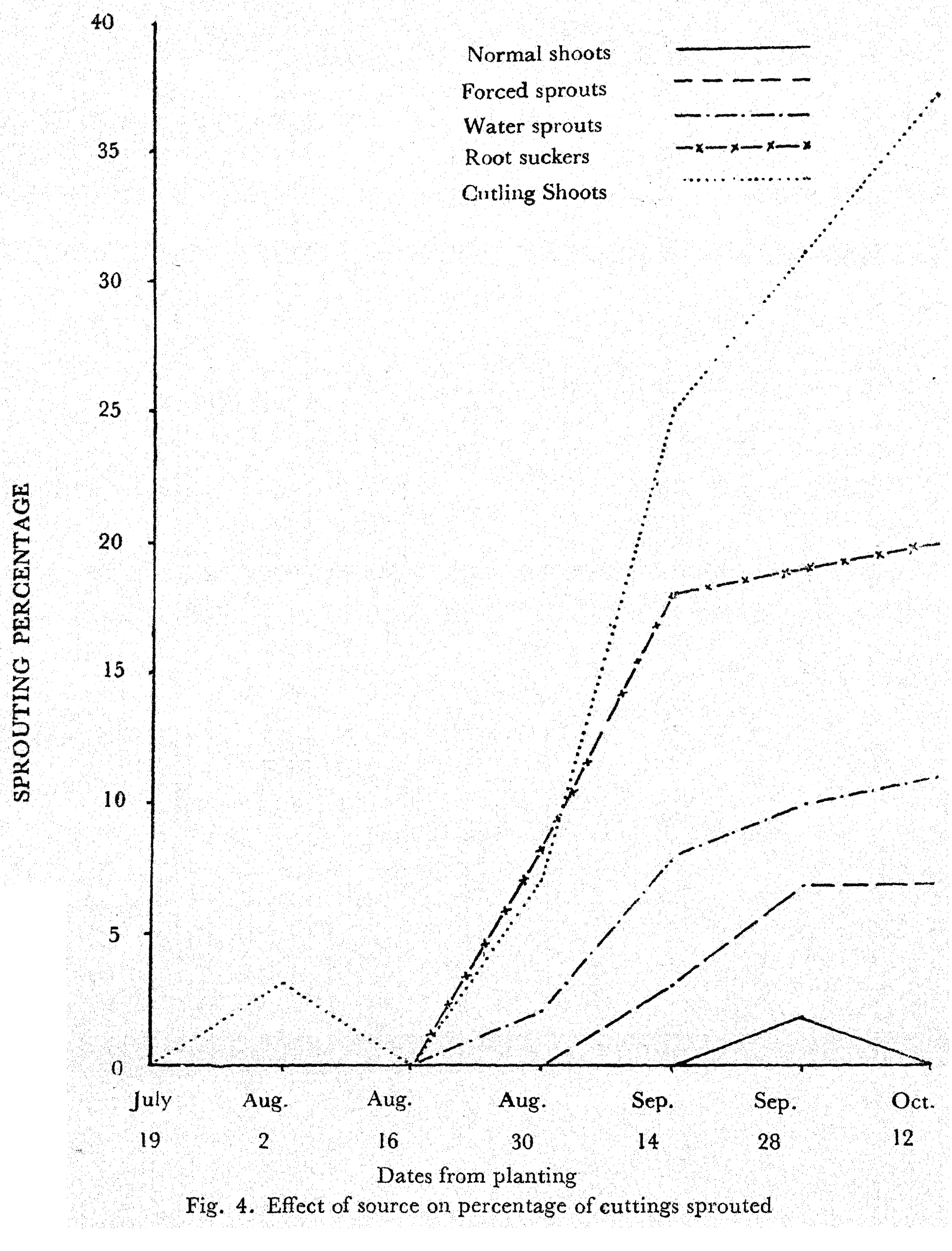

Fig. 4. Effect of source on percentage of cuttings sprouted

third and fourth in cuttings taken from cutting shoots, water sprouts and forced sprouts, respectively. Since there was no rooting in the cuttings from normal shoots, there was no question of any roots in this case.

Fig. 4 presents the percentage of cuttings sprouted. The highest percentage of sprouting was noticed in cutting shoots. The reduction in the percentage of sprouting in this source between August 2 and September 14 was the result of the attack of shoot borer which has been referred earlier. Since the pest was effectively controlled soon after the attack, the curve became smooth after 14th September. The time taken for the start of sprouting, which in all cases was only after rooting, in all sources is well reflected in the sprouting percentage found at final observation. There does not appear to be any marked difference in the rate of sprouting of the cuttings of different sources.

DISCUSSION AND CONCLUSION

The findings of the investigation show that the guava which is so far known to be a very shy rooting plant from hardwood cuttings, can be successfully propagated by softwood cuttings. Hudson(1956)has also reported that many plants which are usually regarded as difficult can be propagated successfully from softwood cuttings using mist. The results have also revealed the paramount importance of the source of cuttings. The cuttings taken from cutting shoots proved to be the best and cuttings taken from root suckers, water sprouts and forced sprouts ranked second, third and fourth, respectively. Normal shoots did not root at all and thus failed to be of any use. The chief possible factors responsible for these differences appear to lie in the vigour, juvenility, hormone balance and food supply (Singh, Garner and Hatcher, 1957 b, Zimmerman and Hitchcock, 1946; and Grace, 1939).

ACKNOWLEDGEMENTS

It is a pleasure to thank Professor S. M. Singh, Head of the Deprtment of Horticulture, B. R. College, Bichpuri under whose guidance this experiment was conducted.

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Pramukh—A New Cotton Variety for Uttar Pradesh

Hari G. Singh, R. K. Mathur and M. M. Bakshi

There are at present two cotton varieties grown in Uttar Pradesh. These are 216F and 320F. Both of these were obtained from Punjab and distributed as such in Uttar Pradesh. Of these 320F is more susceptible to pink bollworm and blackarm disease. The recent shift in the quantum and distribution of rainfall in Western U.P. has also necessitated for evolving an early variety. It has also to be comparatively more resistant to pink bollworm as well as to blackarm disease. Of the two current varieties, 216F is preferred by the cultivators because it is early and enables them to take a crop in the following *rabi* while any crop taken up after 320F gets late, as 320F is a late maturing variety. The maturity percentage of the fibres of 320F was 54% while that of 216F was only 26% during 1963-64. This quality of 320F makes it more acceptable to the mills.

All the good characters of 320F and 216 F have been incorporated in a selection named Pramukh from M4/58. M4/58 itself was a selection from M4 from Sind (Pakistan). M4/58 is a medium long staple cotton having a fibre length of about 23-24 mm. It was however, a low yielder. Hence, further selection was resorted to in M4/58 which has resulted in the new variety Pramukh.

Average performances of the new variety are given in table 1.

Table-1. *Performances of Pramukh and 216F (Average of 3 years i.e. 1961-62 to 1963-64).*

Characters/Variety	Pramukh			216F.		
Yield of *kapas* (Kg./ha.)	613.7			545.1		
Yield of lint (Kg./ha.)	197.06			176.23		
Ginning Percentage	32.11			32.33		
Halo length (mm.)	25.36			24.73		
Mean fibre length (mm.)	23.15			23.15		
Mean fibre weight (m.tex)	153.0			157.5		
	M	H	I	M	H	I
Maturity percentage.	63	—5	—32	26	—14	—60*
Lint index.		3.62			3.49	
Seed index.		7.66			7.31	
Fibre bundle strength in gm tex.		38.0			36.9	*
Bartlett rate index for earliness.		0.66			0.60	
Jassid grade.		II-III			II-III	
Oil content		17.5%			16.76%	*
C.S.P. at 40s.		1477.5			1479.0	

* Values only for 1963-64.

It will be seen from the data above that Pramukh has given higher yield than 216F (Control). It has also produced more lint per hectare although the average ginning percentage of Pramukh is slightly lower than that of 216F. In halo length Pramukh is sperior to 216F. However mean fibre length of both the varieties is the same. In mean fibre weight again Pramukh has produced finer fibre (153 m. tex) as against 157.5 m. tex in case of 216F. The maturity percentage of fibres of the new variety is also very much superior (63%) to 216F (26%). The maturity percentage of fibres of this variety is also higher to 320F (54%). Both the lint index and seed index of Pramukh is superior to 216F. This new variety is even earlier than 216F and thus will enable the cultivators to take a *rabi* crop even a little earlier, than they are able to take with 216F. Pramukh has also been found to be more resistant to pink bollworm than 216F and 320F. As far as its susceptibility to jassids is concerned, it is almost at par with 216F. In oil content also Pramukh is superior to 216F.

The economic characters of Pramukh and 320F are given in table 2.

TABLE-2. *Economic characters of Pramukh and 320F (1962-64)*

Varieties	Yield of kapas in kg./ha.	Ginning percentage.	Mean fibre length in mm.	Mean fibre weight in m. tex.	Maturity percentage.	Jassid grades.	Bartlett's rate index.	Pink Boll-worm infestation in%
1	2	3	4	5	6	7	8	9
Pramukh	991.66	33.41	23.63	177	63.79	2.42	0.74	28.74
320F	885.05	33.80	23.93	166	54.70	1.93	0.65	33.62
Percentage increase Over 320F	12.05	(—)1.15	3.05	6.81	14.52	25.39	13.85	(—)14.52

As Pramukh matures about a fortnight earlier than 320F successful cultivation of wheat after harvesting this variety has now become a practical proposition. Now a wheat crop (Np 830 & K. 68) of about 15 Qtls. per hectare can easily be taken after harvesting about 10 Qtls. of *kapas* per hectare from this variety from the same land.

This variety was also tested on Govt. Farms as well as on cultivators' fields during 1963-64. The yield of *kapas* on Govt. Farms is given in table 3.

TABLE-3. *Performances of Pramukh at Government Farms.*

Farm	*Variety* Yield of Kapas in Kg./ha.			
1. Govt. Cotton Research Station Raya, Mathura.	*Pramukh* 312.2	*216F* 270.3	*320F* 258.1	*C.D. at 5 %* 46.64 Kg./ha.
2. Govt. Research Farm Keserwa, Budaun.	*216F* 774.3	*Pramukh* 678.3	*320F* 634.8	N.S.
3. Govt. Agriculture Farm Kalai, Aligarh.	*Pramukh* 523.0	*216F* 513.7	*320F* 495.0	55.00 Kg./ha.

Pramukh was also tested on cultivators' fields. The results obtained are given in Table 4.

TABLE-4. *Performances of Pramukh on Cultivators' fields.*

District	Variety Yield of Kapas in Kg./ha.			
1. Agra	*Pramukh* 1144.9	*216F* 1038.67	*320F* 1010.85	*S. E.* 68.82
2. Bulandshahr	*Pramukh* 560.90	*320F* 556.57	*216F* 528.38	31.60
3. Aligarh	*216F* 339.5	*Pramukh* 325.27	*320F* 303.58	17.50
4. Etah	*216F* 425.01	*Pramukh* 386.95	*320F* 382.37	22.06

Pramukh was also tested on cultivators' fields in Raya Block Mathura during 1962-63. It gave on an average higher yeild (1193.94 Kg./ha.) than 216F (1151.53 Kg./ha.)

The yield of Pramukh on Government Farms as well as on cultivators' fields also on the whole was favourable as at most of the places it has given higher yield than 216F or 320F. Thus it appears that this variety will be acceptable to cultivators and mills alike and therefore has been released during the year 1965-66 by the U.P. Department of Agriculture.

Striga lutea Lour., The Enemy of Sorghum vulgare Pers.

D. P. Joshi*

INTRODUCTION

Striga lutea Lour., (Vern. Agia), a phanerogamic root parasite, is one of the eminent parasites of Sorghum as reported from Africa, India and Burma. It takes the food of the economic plants like sugarcane and jowar affecting the yields adversely and consequently cooperating the other evils in causing the food problem, particularly in the Indian states like M.P., Bombay, Andhra Pradesh and Madras. Therefore, minimization of the evils of such an enemy of sorghum to the maximum possible extent should also be one of the targets for stepping up production, especially when other factors are not sufficiently adding to produce the maximum out of the resources available at this high time.

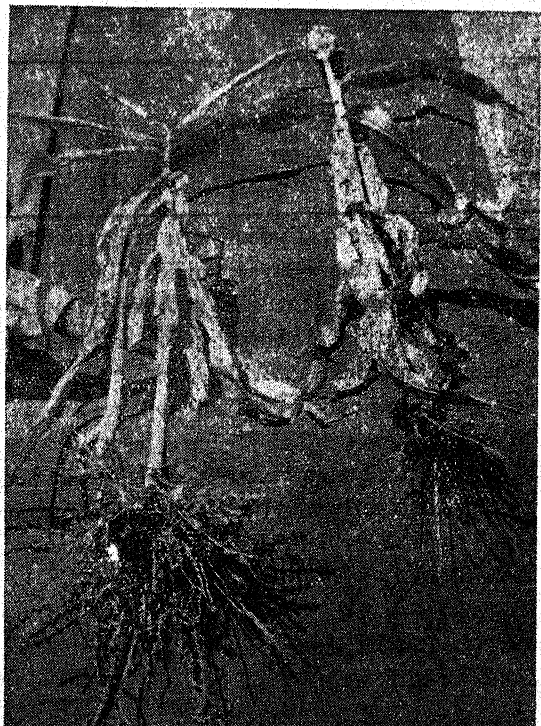

Plate 1. Striga affected and control Sorghum plants.

Review of Literature: Though earlier investigators like Dastur (1937), Kumar and Solomon (1941), Kumar (1954), Ramkrishnan (1963), Srinivasan (1947) and Aiyer (1954) have presented a detailed picture of various aspects of Striga including its hosts, mode of infection

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and its preventive and central measures, the loss caused by it has been assessed in the present investigation, so, that the magnitude of the problem may be realized by the farmers and the research workers handling this crop and the solutions to be observed may consequently be initiated.

MATERIAL AND METHODS

Five groups of sorghum plants each containing 50 plants were observed for the infection and consequent loss caused by *Striga lutea* Lour., at Govt. Agri. Farm, Nowgong (M.P.) under local conditions of Chhatarpur district.

RESULTS AND DISCUSSION

Plate No. 1 indicates the healthy and the Striga-affected plants of Sorghum, which also depicts that not only the vegetative growth of the plant was hampered, but the emergence of the earhead was completely checked resulting in the complete failure of the plant to produce grains. The other findings are presented in the table given below:

TABLE I *Showing the % of infection and loss caused by S. lutea Lour*

S No.	No. of plants Observed	% of infection Infected plants	%	Plants failing to set seeds	% of infected plants failing to set seeds
1.	50	45	90	43	95.5
2.	50	37	74	31	83.8
3.	50	41	82	35	85.4
4.	50	26	52	22	84.6
5.	50	39	78	11	28.2

The table clearly indicates that the % of infection noted varied from 52% to 90% showing the magnitude of the problem under investigation. The loss borne by the infected plants as depicted by the % of infected plants failing to set grains, is from 28.2% to 95.5% showing the chances of failure of the plants to yield grains and hence a great loss to the producer, if the crop is not carefully handled, for which wide spacing intercultivation and hand weeding before flowering, deep cultivation and an application of powdered copper sulphate, Agroxone (MCPA) and Fernoxone (2, 4-D) have been advocated as control measures that may be observed. Besides, the Striga resistant varieties of Sorghum may be grown to avoid the aforesaid losses, particularly when Striga is holding up production of this crop. Some of the Striga resistant varieties of Sorghum are as follows:

Exotic: 1. Bonganhilo (Africa)
2. Y. K. (Burma)

Others: 1. Bilichigan (for Bombay state)
2. Agyalkodal (for M.P. state)
3. Illendi
4. Nandyal
5. Mallemari
6. Col. 20

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"Studies on the bionomics and control of Phyllocnistis Citrella Stainton."

S. S. Khanna and Y. D. Pande

INTRODUCTION

Citrus belonging to the family Rutaceae constitutes an important group of fruits which are proverbially rich in their dietic and therapeutic values for which their cultivation has been taken up extensively throughout the tropics and sub-tropics of the world. *Phyllocnistis citrella St.* is a major pest of citrus and is very destructive to leaves of oranges, lemons and other citrus varieties. Besides, citrus, it also mines the leaves of *Bael* (*Aegle marmelos*) *Murraya koenigi*, *Murraya exotica*, *Loranthus*, Willow (*Salix Sp.*) *Jasminum Sp.* and *Pongamia glabra*. The attack in all these cases is of little importance.

Very little attention has been paid to the study of bionomics and control of *Phyllocnistis citrella* St. in India or abroad. Rehman (1940) reported serious attack of the pest on *Citrus Sp.* in Punjab and found egg, larval and pupal periods of 2-10, 5-30 and 5-25 days respectively. Pruthi and Mani (1945) reported the pest on various species of citrus and also on *Murraya exotica*, *M. koenigi*, Loranthus, Willow (*Salix Sp.*), *Jasminum cinnamonum*, *J. sambac* in India. The egg, larval and pupal periods occupy 2-5 days, 1-2 weeks or more, and 1-3 weeks respectively. Rehman and Yunus (1945) reported it as a pest of citrus Sp. in Punjab completing its life cycle in 12-65 days, viz., egg stage 2-10 days, caterpillar 5-30 days and pupal stage 5-25 days. Lal (1949) reported it as serious pest of lemon, orange, pomelo and grape fruit, etc. and egg, larval and pupal stages last for 2 or 3-10, 7-30 and 10-20 days respectively and the whole life cycle is completed in 3-9 weeks. He reported 13 generations in Punjab and 9 generations in U.P. in a year.

MATERIAL AND METHOD

The life history of the pest was studied in the laboratory as well as in the field. The rearing work in the laboratory was carried out in glass chimneys, jars, petridishes and specimen tubes. The mouth of the jars and chimneys were covered with muslin cloth for free passage of vapour and air. The adult moths emerging from the pupae were confined to the chimneys with a small twig of citrus for oviposition. For this purpose newly emerged small twigs were taken from the nursery plants. These twigs were bagged with tissue paper on the plants previously in order to protect them from insect attack. The moths were fed upon weak sugar solution (2-3%) soaked in cotton wool and placed inside the chimney. The food was renewed twice a day, in the morning and evening. The pre-copulation, copulation and pre-oviposition periods were noted.

To find out the fecundity of female moth, one pair of moths were introduced in each chimney in which tender twigs were kept and the number of eggs laid were counted daily. These small twigs were transferred to petri dishes for observing the mode of hatching and other habits of newly emerged caterpillars.

Because the eggs are laid on the tender newly emerged leaves of plants and the isolated leaves kept in petri dishes wither and dry and the entire caterpillar stages cannot be studied

on a single leaf, therefore, for the study of caterpillar stages, tender twigs of attacked nursery plants were taken and kept in specimen tubes, filled with water, so that leaves may not wither and dry for a pretty long time. On these twigs the study of different stages of the caterpillar, viz., their colour, size and other morphological characteristics were observed.

Pupated caterpillars were transferred to the petri dishes and the emerged moths were transferred to chimneys for observations on their longevity.

The study of the pest under laboratory conditions was done only up to the month of October-November. Afterwards when the temperature went down resulting in the lengthening of larval and pupal stages, the life-history of the pest could not be carried out in the laboratory.

In field conditions, pairs of moths were transferred to bagged nursery plants and the total number of eggs laid by each female was noted and then the bags were removed for observing the later stages of the pest.

Field observations were made to find out the food preference on 7 varieties of citrus, available in the botanical garden, Government Agricultural College, Kanpur. Since the pest invariably infests fresh top and terminal foliage, the fresh growth in every month was marked by tags. The total number of fresh leaves produced by the plants was recorded and the number attacked by the pest was counted monthly. The observations were recorded in terms of percentage of attack.

The host preference for oviposition was also studied in detail. For this purpose 50 infested leaves of each of the food plants was collected at random and examined carefully for the presence of eggs and mines and the percentage of infestation was noted.

The length of mines on different food-plants varies considerably. This fact was studied critically to see whether mine length could form an index to host preference. For this purpose 50 mines were selected at random from infested leaves of each of the food plant and measured by means of a divider. The minimum and maximum lengths were noted and average length calculated from these.

For the study of sex-ratio, moths emerged from the pupae were separated on the basis of their external characters and ratio of male and female was worked out.

Damage

Observations were carried out to determine the susceptibility of different varieties of citrus in different months of the year and the extent of damage in each variety was noted and its percentage calculated. The results are presented in the following table:

TABLE 1. *Susceptibility percentage of different varieties of citrus in different months of the year to the attack of **P. citrella** St.*

S. No. Varieties	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April
1. Sweet orange	50.0	55.5	90.0	92.5	50.0	15.0	19.5	22.0	25.0
2. Sweet lime	51.0	60.5	70.0	72.0	30.5	18.5	19.0	23.0	24.5
3. Lime	20.0	23.0	30.0	35.5	18.5	10.5	11.0	13.5	14.0
4. Elephant lemon	48.5	60.0	92.5	99.5	45.0	15.0	22.5	25.0	27.5
5. Pummelo	20.0	32.5	40.0	45.5	20.0	10.5	12.5	15.5	17.5
61 Pomelo	30.0	45.5	60.0	68.5	22.5	13.0	15.0	16.5	18.5

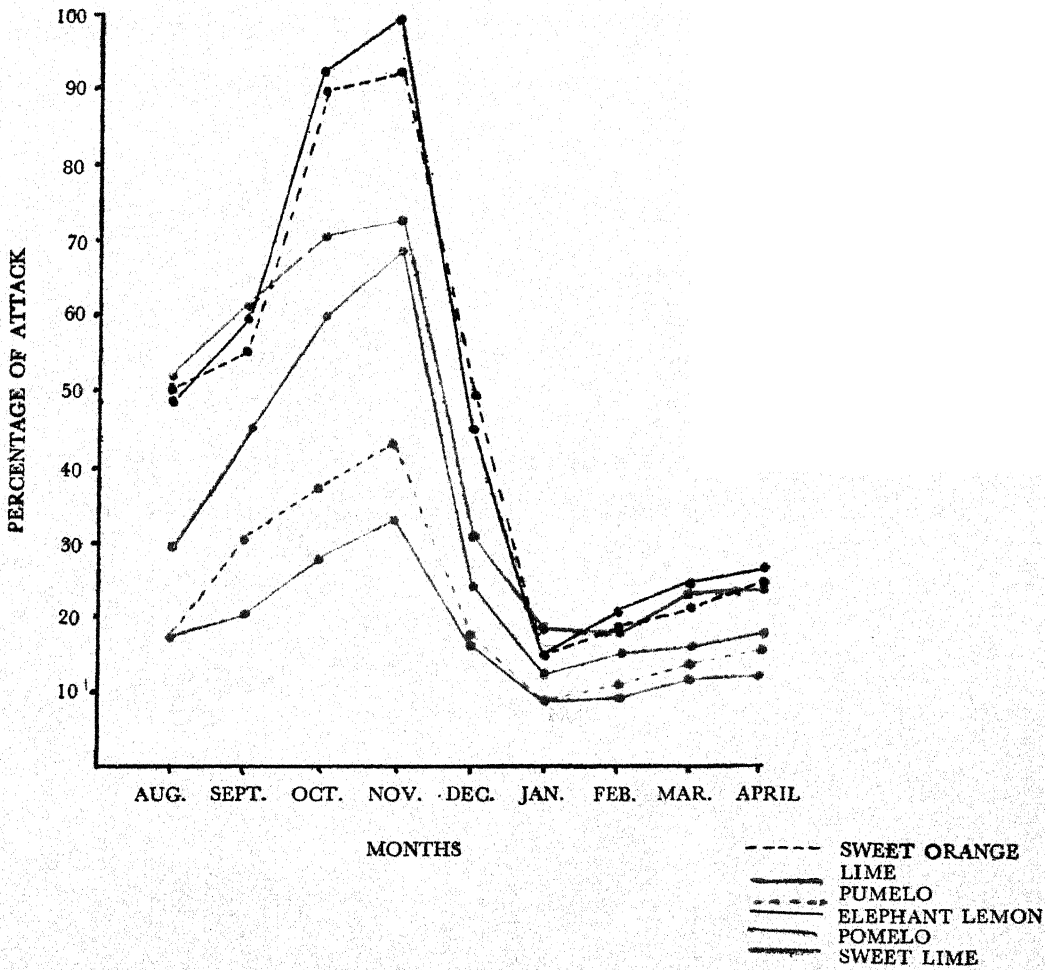

Plate 1.

Graph showing the attack of *phyllocnistis citrella* St. on different varieties of citrus in different months of the year

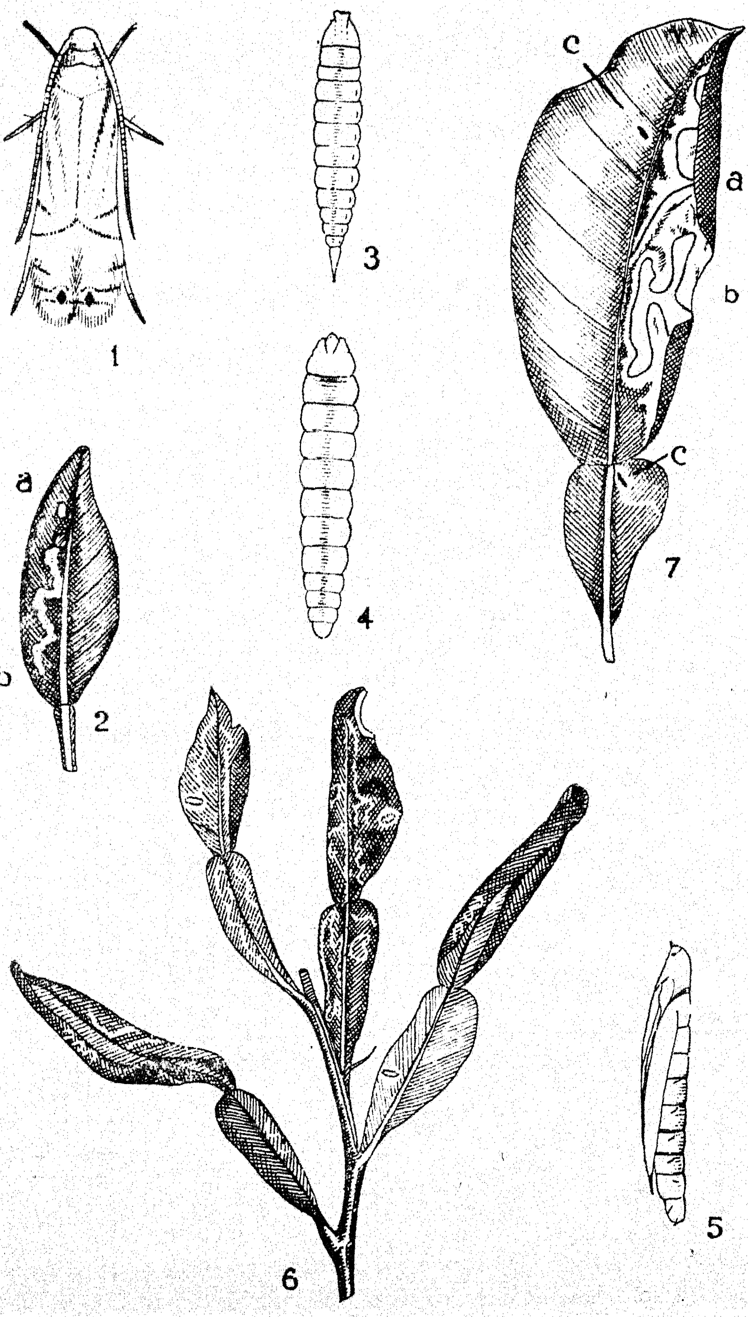

Plate 2.

EXPLANATION OF THE PLATE

Fig. 1. Moth, resting position, x 15.
Fig. 2. Young citrus leaf enlarged to show egg at 'a' and young larva mining at 'b'
Fig. 3. Leaf-mining stage of larva. x 15.
Fig. 4. Mature larva, x 15.
Fig. 5. Pupa, lateral view, x 15.
Fig. 6, Young citrus shoot showing injury caused by leaf-minor.
Fig. 7. Mature leaf, showing folded edge at 'a' and old damage at 'b'. Dark parasite pupas shown at 'c', 'c'.

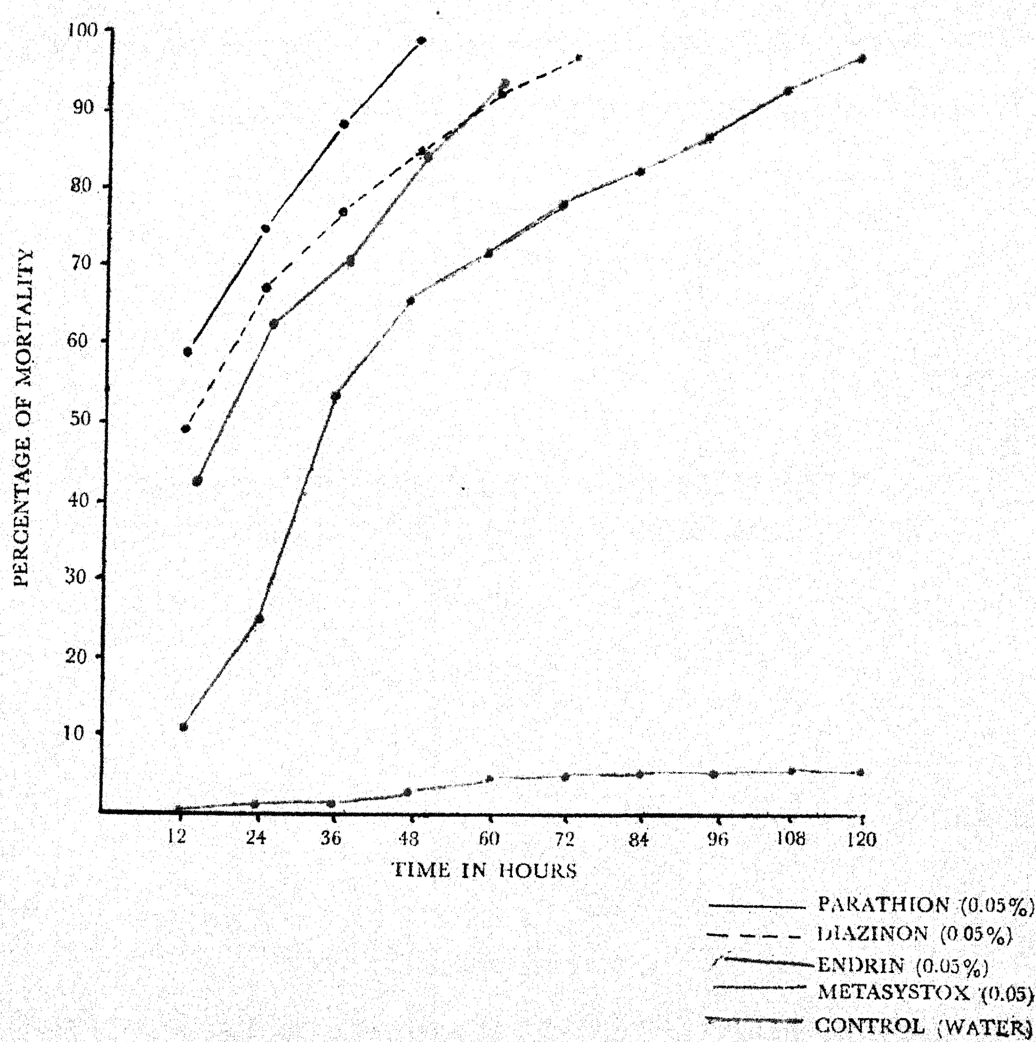

Plate 3.

Graph showing average percentage mortality of larvae (*P. Citrella*) in different treatments

It is clear from the above table that the attack on all varieties of citrus is severe. Elephant lemon (*Citrus medica*) which has succulent leaves is heavily damaged, while lime (*Citrus aurantifolia*), sweet lime (*Citrus limethodes*), Pummelo (*Citrus maxima*) and Pomelo (*Citrus paradisi*) were less affected.

Table 1 also shows the activity of the pest in different months of the year. The pest activity increases from August to November and declines as winter progresses. The activity is again resumed in the spring season (February and March) and then again declines gradually with the commencement of summer.

Nature of damage—Phyllocnistis citrella St. attacks only the younger and tender leaves, causing them to become distorted and curled up. The typical injury at this stage is seen as irregularly twisted galleries and the epidemics appearing as a silvery film. As the larva feeds and moves about it leaves behind it along with the middle of the gallery a narrow line of semi-liquid excrement which is whitish at first, but turning brown with age. After the leaves have become old and hard, they are no longer liable to attack. Occasionally under severe infestation the succulent branches of the young shoots, specially those of orange and grape fruits are also mined by this pest.

Extent of damage—The extent of damage in the form of mines was recorded. The length of the mines on different food-plants varies considerably. The record of these measurements is given in the following table:

TABLE 2. *Maximum, minimum and average length of mines in different varieties of citrus.*

S.No.	Varieties	Maximum length	Minimum length	Average length
1.	Elephant lemon	11.8″	5.9″	7.5″
2.	Sweet lime	8.0″	5.1″	6.3″
3.	Lime	6.0″	4.8″	5.4″
4.	Sweet orange	9.5″	5.0″	7.0″
5.	Pummelo	11.0″	4.8″	7.2″
6.	Pomelo	10.5″	6.0″	6.9″

It is evident from Table 2 that elephant lemon (*Citrus medica*) has the maximum length of mines (11.8″) and therefore, seems to be the most favourite food plant. The lime (*Citrus aurantifolia*) having the minimum length of mine (4.8″) is least preferred. The remaining varieties of citrus took mid position in case of food preference.

Life History

Copulation—In confinement, moths were observed to copulate for the first time 15.1 to 22.2 hours after their emergence. Copulation takes place mostly at night or in the early hours of morning. Mating occurs in dark or dim light. During the act of copulation the male becomes attentive to female, moves after her and searches for the tip of her abdomen and sit calmly tail to tail in opposite directions. As soon as the union is affected both sexes become quiet, motionless and sluggish. If disturbed during this period they move slightly but remain in the same position till mating is over. Copulation takes place once in the life time of a female. Copulation period varies from 15-30 minutes.

Oviposition—The oviposition starts 13 to 24 hours after the copulation. It was observed that under laboratory conditions egg laying always starts at night. Before oviposition the female becomes restless and flies actively. It then settles on a leaf or tender top branch, touching the surface by the tip of its abdomen, lays a single egg and flies to another leaf or twig. Eggs are laid singly but often 2 eggs may be found very close to each other. The eggs are firmly attached to the leaf or twig. The oviposition period varies from 2 to 6 days. Eggs are mostly laid on the under surface of the leaf near the midrib but under heavy infestation succulent branches are also preferred. The number of eggs laid by each female varies from 36-76 with an average of 40 eggs. Maximum egg laying takes place during the monsoon and the number reduces as the winter months approach.

Eggs—The eggs, when freshly laid, are minute, oval, slightly convex and measure about 0.31 mm in length and 0.21 mm in width. The colour is light green but changes to pale yellow with the advance of age. The eggs are very soft and each is covered with a shiny film of secretion.

Incubation period—The inubation period depends upon the prevailing temperature and humidity. It is shorter at high temperature and high humidity and vice-versa. Under laboratory conditions it varies from 2-4 days from March to October, 5-7 days from November to December and 9-10 days in January.

Larval Instar

First instar—The newly hatched larva is about 0.74 mm in length and 3.33 mm in breadth. The larva on hatching enters the leaf tissues and feeds as a leaf miner. It is flat, pale greenish yellow and of a shiny glossy appearance. The first moulting may take place at any time within 1-4 days.

Second instar—Just after moulting the second instar larva becomes active. Except the size there is no other marked differentiation with the first instar. It measures on an average 2.26 mm in length and 0.52 mm in breadth. The duration of the second stage larva varies between 1-5 days.

Third instar—The larva apparently has no legs, but moves inside the gallery by undulations of the body as in other earlier instars. Between the antennae a flat oblong plate is projected with its front edge rounded. The larva contains disc shaped mandibles. As the larva advances in its gallery the front edge of this flat plate is pushed forward to raise the epidermis, while the mandibles remain in the horizontal plane, cutting the cell tissues. It measures on an average 3.79 mm in length and 0.76 mm in breadth. The duration of the larvae varies from 2 to 5 days.

Fourth instar—The larva is cylindrical and of a dull yellow colour with a small head. It meaures on an average 4.99 mm in length and 1.03 mm in breadth. The duration of the fourth instar larva varies from 8 to 6 days.

The larval period varies 5 to 11 days during March to October and 12 to 20 days during November to February. Thus the total larval period occupies from 5 to 20 days.

Prepupal stage—Before pupation the full grown larva becomes sluggish, shrinks in size and stops feeding. The colour of the body becomes yellowish-white. The average reduced size at this stage measures 4.2×0.75 mm as against the original length of 5.2×1.05 mm. Prepupal period occupies 4-20 hours in different months.

Pupa—The pupa is brownish in colour provided with a very small sharp spine on its head with which it cuts the wall of the gallery and projects out its anterior half of the body. The male pupae are usually smaller in size than the female pupae. The length and breadth of pupae vary from 3.00 to 3.12 mm and 0.52—0.54 mm respectively in case of males and 3.46—3.52 mm and 0.58—0.62 mm respectively in case of females. Pupation usually takes place inside white silken cocoons under folded leaves formed by grown up caterpillar before going into prepupal stage but sometimes it also pupates inside the mines of the young succulent branches. Pupal period varies from 6-22 days.

Adult—When the development of moth is completed it emerges through the anterior end of the cocoon by cutting it with the help of spine and the pressure extended due to the movement of the moth inside the puparium.

The adult moth is very small, silvery white in colour and measures about 4.2 mm in wing expanse. The hind wings are white, the fore wings have brown stripes and a prominent black spot near the apical margin. Both pairs of wings are fringed with minute hairs. There is no marked difference between male and female except the size, the former being smaller in size than the latter. The abdomen of the male is pointed while it is somewhat rounded in female. Moths of both sexes are entirely nocturnal in habit.

Longevity of moth depends much on the weather conditions and availability of the food material. It has been observed that the female lives considerable longer than the males. The longevity of male and female moths varies from 2-4 days and 3-8 days, respectively. Moths survived longer during winter than in summer and rainy season. The sex ratio of male and female was almost the same and never varied from the ratio of 10:12.

The total period required for completing one life cycle was much variable because of change of climatic conditions. It completed one life cycle in 13-18 days in August-September 23-33 days in October and November and 37-52 days in February and March.

Seasonal History

The insect remains active throughout the year but the serious infestation starts from July with the lowering down of atmospheric temperature from high to moderte and increasing of humidity from low to high. Heavy infestation continues up to the end of October after which the attack goes down with the advent of winter. Serious infestation has also been observed during February and March when the atmospheric temperature and humidity were of moderate type but during this period the infestation does not reach as high as in monsoon months. From April to June the activity of the pest is retarded which indicate that high temperature and low humidity conditions are not favourable for the multiplication of the pest. Activity of the pest is also correlated with the availability of the fresh leaves and succulent. twigs which are found in February and March and from July to October. Under laboratory conditions six generations were recorded during August to March.

Control

Various methods of control against the citrus leaf miner have been tried by several workers. Pruthi and Mani (1945) reported repeated sprayings of rosin soap-nicotine sulphate compound or an emulsion of *Pongamia* seed oil for effective control in Mysore. Rehman and Yunus (1945) found most effetive way to control this pest by spraying affected plants thrice at an interval of 10-14 days during April-May and September-October with nicotine sulphate and fish oil rosin soap (1:8:800) or with tobacco decoction soap. Lal (1949) reported that spraying with 1 per cent DDT gave 70 per cent kill of this pest. In 1953 he claimed 85.7 per cent mortality by suspension of DDT in nicotine sulphate and 100 per cent by 0.1 per cent parathion. Fakuda and Yohozawa (1952) recommended BHC and Pyrethrin mixture as a useful substitute for nicotine sulphate against this pest in Japan. Gandhi (1956) recommended application of a spray containing 1 lb nicotinesulphate (40 per cent), 4 lb soap and 4 lb 50 per cent wettable DDT in 80 gallons of water at an interval of 20 days after the new growth have been put forth. Bindra (1957) found 0.2 per cent of DDT or BHC suspension effective. Srivastava (1957) recommended spraying of plant with 0.1 per cent Parathion emulsion for its effective control. He has also recommended spraying of 0.25 per cent DDT suspension in nicotine sulphate and nicotine in kerosene soap emulsion for its control.

The authors have tried some of the modern insecticides, viz., Endrex 20 EC, Parathion, Diazinon and Meta-systos against this pest. All the four insecticides were sprayed in a seriously affected nursery plantings in the citrus orchard of the Government Agricultural College, Kanpur, during 1963. The trial was laid out in randomised block design in three replications. The insecticides were used in emulsion form at 0.05 per cent strength. The efficacy of the insecticides was judged by observing the reduction in the number of caterpillars on treated plant leaves. Mortality of the larvae were observed at 12, 24, 36, 48 and 60 and 72 hours after spraying. The recorded mortality has been presented in the table given below:

TABLE 3. *Efficacy of various modern insecticides in reducing population of citrus leaf minor, P. citrella.*

Treatments	Per cent mortality of the larvae in hour					
	12	24	36	48	60	72
Endrin 0.05 percent	42.3	63.4	78.3	84.3	93.0	93.0
Parathion 0.05 per cent	59.0	74.9	88.7	98.5	98.5	98.5
Diazinion 0.05 per cent	48.4	67.5	77.8	85.3	92·7	97.2
Metasystox 0.05 per cent	10.7	26.0	53.5	64.8	70.9	76.3
Control (Water spraying only)	1.0	1.7	1.7	3.3	4.1	4.1
C. D. at 1 %	—	8.6	—	14.4	—	—

It is evident from the above data that parathion gave highest and quickest mortality within 48 hours, followed by Diazinon and endrin. Performance of metasystox was poor and could not compete with other insecticides even after 72 hours after spraying.

SUMMARY

Phyllocnistis citrella is a major pest of citrus and is very destructive to the leaves of orange, lemons and other citrus plants. Besides citrus, it also mines the leaves of *Bael* (*Aegle marmelos*), *Murraya exotica*, Loranthus, Willow (Salix Sp.), *Jasminum* Sp. and *Pongamia glabra.*

The precopulation period varies from 14-15 hours to 24.10 hours with an average of 18.08 hours. Copulation period varies from 15-30 minutes. Preoviposition and oviposition period varies from 13-09 hours to 24.32 hours and 2-6 days respectively. Eggs are mainly laid on the underside of the leaves. Incubation period varies from 2-10 days. There are four larval instars. Total larval period occupies 5-20 days. Pupal stage occupies 6-22 days. The complete life cycle takes about 13-33 days.

Insect remain active throughout the year but the infestation is very serious during July to October and again in February-March. Under laboratory conditions 6 generations were recorded during August-March.

Trials were also made to control the pest. Parathion, Edrin, Diazinon and Metasystox in 0.05 per cent strength were used. Parathion gave the best results as it gave 98.5% mortality within 48 hours. The next effective insecticide was Diazinon which gave 97.24 per cent death in 72 hours and endrin took third position in effectiveness. The effect of Metasystox was very slow and it gave 94.67 per cent deaths in 5 days.

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Treatment With Plant Regulators and their Effect on Dry Matter Production in Onion (*Allium Cepa L.*) Variety Patna Red

C. P. Vaish

Treatment with plant regulators has come into prominence to increase germination of seeds, vegetative growth of plants and their yield. (Michel, 1951; Asana *et al* 1955; Garg, 1959; Chaudhary and Singh, 1960; Vaish, 1962 and 1965). The experiments of Templeman (1929), Dastur and Bhatt (1955) and Mukerjee and Kumar (1956) reveal that dry matter content in plant was also affected by plant regulating substances. In view of the above reports, the present investigation was carried out to study the effect of a-naphthaleneacetic acid (NAA) and B-indolebutryic acid (IBA) as presowing seed treatment and pre-planting seedling treatment on the dry matter production in onion variety Patna Red.

METHODS AND MATERIAL

The experiment was planned on field scale, in two sets, at the Jat Vedic (Post-graduate) College Farm, Baraut (Meerut), U.P., during 1961-62. The treatments were randomised with three replications and seven treatments in each set. After harvesting the preceding crop of Jowar the field was ploughed well and adequate Farm Yard Manure was added to the experimental plots. NAA and IBA, both were tested in three concentrations, viz., 1, 10 and 100 ppm. Only bold and disease free seeds were selected for experimentation.

Treatment of Seeds: In one set of the experiment the seeds were wrapped in fine muslin cloth and immersed in hormonal solutions kept in glass containers. The duration of treatment was mantained to be 8 hours. Control treatment was given by soaking seeds in distilled water for the said duration. After completion of the treatment seeds were wiped dry of the adhering moisture and subjected to air drying. The seeds were planted on well prepared nursery beds on 7th Oct, 1961, for raising of seedlings.

Treatment of Seedlings: In the other set of experiment where effectiveness of growth substances was to be seen as pre-planting treatment of seedlings, the nursery was raised with untreated seeds. After the seedlings attained a height of about 6" they were taken out from the nursery beds, washed gently and subjected to hormonal treatments. The seedling roots were immersed in aquous solutions of NAA and IBA for 8 hours. Control was also maintained by treating seedlings with distilled water. After completion of treatment the roots were washed with distilled water and transplanted at 6" $\times$ 6" distance. Irrigation, hoeing and weeding was given at regular intervals.

Dry weight of plant, its leaves, roots and bulbs was recorded three times in the life cycle, viz., 20, 40, and 60 days after transplantation. For the purpose random composite samples of five plants were drawn from each plot and were subjected to drying at a constant temperature of 70° C. Data recorded were statistically computed by Fisher's Analysis of Variance method as referred by Paterson (1939).

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EXPERIMENTAL FINDINGS

Seed Treatment: The dry weight of plants was taken at 20, 40 and 60 days of plant growth. The data obtained have been presented in Table I. Similarly dry weight of leaves, roots and bulbs was also recorded which have been shown in Table II. The values have been found highly significant to the extent of 1% level. It is of considerable interest to note that different hormonal treatments influenced the plant behaviours in different manners. It may be stressed that whereas lower concentrations of NAA and IBA have enhanced the growth, higher dosage of the order of 100 ppm seems to be toxic as they had reduced the plant growth to a considerable extent (Photo Plate I). A look to Table I reveals the trend of hormone action. The dry weight of the plants at 20 days of growth was 118.66 mgms. in control whereas the same could be attained to the extent of 164.00 and 166.00 mgms in case of plants treated with 10 ppm, NAA and IBA respectively. Lighter dosage of the order of 1 ppm had also a stimulating effect, of course of a lesser degree as compared to treatments of 10 ppm. Contrary to this, the treatment of higher dosge concentration (100 ppm.) were definitely depressing in nature (Table I).

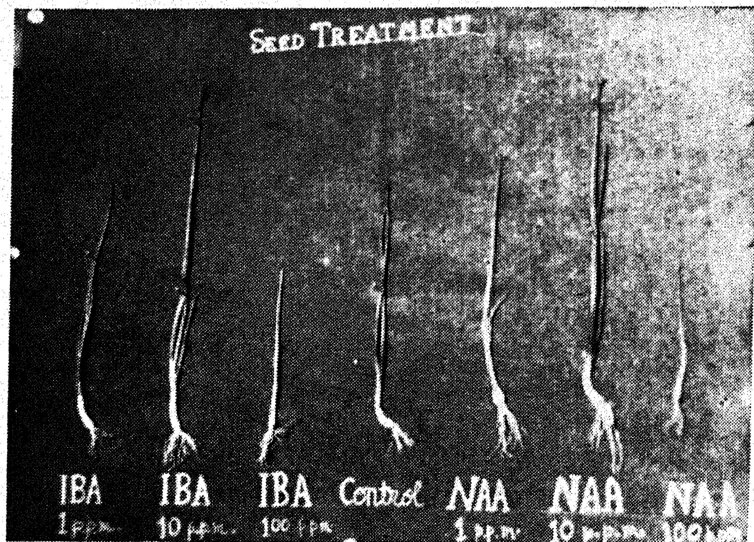
TABLE I. *Effect of seed treatment with NAA and IBA on the dry weight of onion plant at different stages of life cycle, duration of treatment 8 hours; 3 replications; average of 5 plants in each replication.*

Treatments		Dry weight of plants in Mgms at the age of		
		20 days	40 days	60 days
Control		118.66	161.66	246.00
NAA	1 ppm.	140.00	126.66	277.33
NAA	10 ppm.	164.00	206.66	335.00
NAA	100 ppm.	108.00	126.66	171.66
IBA	1 ppm.	132.00	188.33	287.33
IBA	10 ppm.	166.00	198.33	339.66
IBA	100 ppm.	108.66	126.66	179.33
'F' Value		75.18*	112.22*	170.89*
C.D. Value at 5% level		8.55	9.71	11.75

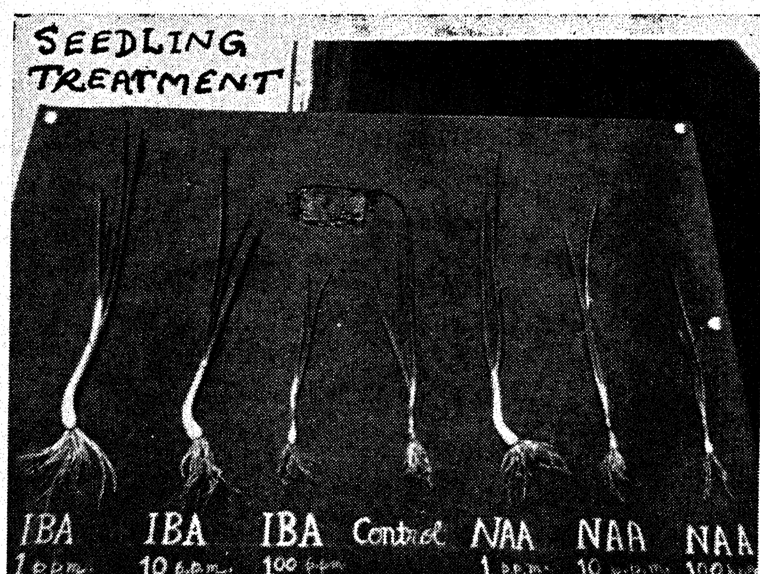
*Significant at 1% level

The dry weight of plant at later stages, i.e., 40 and 60 days of growth were also affected. The trend of effects virtually followed the same as referred above.

Dry matter accumulation in roots, leaves and bulbs was also noted. Plants treated with 10 ppm. IBA produced maximum dry matter followed by treatment with NAA at the same concentration. Lower dosage of the order of 1 ppm. were also stimulating in effect than the control. Higher dosage of 100 ppm. in both plant regulators had got depressing effect as the dry weight was much reduced (Table II).



Photo–plate–I:—Showing growth of Onion plants following pre-sowing seed treatment with plant regulators, 20 days after transplantations.



Photo–plate–II:—Showing growth of Onion plants following pre-planting seedling treatment with growth regulators, 20 days after transplantation.

TABLE II. *Effect of seed treatment with NAA and IBA on the dry matter content in leaves, roots and bulbs of onion plant at different stages of life cycle, duration of treatment 8 hours, 3 replications; average of 5 plants in each replication.*

Treatment.	Dry weight of leaves (Mgms) at the age of			Dry weight of roots (Mgms) at the age of			Dry weight of bulbs (Mgms.) at the age of		
	20 days	40 days	60 days	20 days	40 days	60 days	20 days	40 days	60 days
Control	74.66	88.33	100.66	16.00	23.66	38.33	28.00	42.66	98.66
NAA 1 ppm.	78.66	104.33	113.00	24.00	35.00	46.33	32.00	46.33	118.00
NAA 10 ppm.	114.00	120.00	141.66	28.00	36.00	57.00	38.00	51.66	136.33
NAA 100 ppm.	68.66	63.33	72.00	12.00	20.00	32.66	23.30	35.33	67.00
IBA 1 ppm.	84.00	102.33	116.66	18.00	35.00	47.33	30.00	43.66	123.33
IBA 10 ppm.	116.00	116.00	144.00	24.00	38.66	57.33	38.00	44.33	138.33
IBA 100 ppm.	68.66	62.00	72.66	13.33	28.66	30.00	20.00	35.66	76.66
'F' Value	13.10*	35.61*	279.56*	70.02*	5.77*	62.21*	26.20*	16.53*	34.63*
C.D. value at 5 % level.	16.22	7.45	5.38	3.31	4.71	4.16	4.09	4.57	4.75

*Significant at 1 % level.

Seedling Treatment: Observations pertaining to dry weight of plants have been presented in Table III and dry weight of roots bulbs and leaves have been summarized in Table IV. A survey of the data recorded in table-III reveals the result of the action of the growth substances used. Lower concentration of the order of 1 ppm. had stimulated the plant in dry matter accumulation at the same time higher concentration of 100 ppm. showed toxic effects. Control plants yielded 127.00 mgms dry matter whereas the same was raised up to 186.00 mgms. in case of plants treated with IBA and 180 mgms in case of plants treated with NAA at 1 ppm. respectively, at 20 days age. Medium concentration (10 ppm.) of both plant regulating substanes, also produceed stimulatory effect but to a lesser degree.

Besides, encouraging effect of the lower and medium concentration (1 and 10 ppm.) higher dosage (100 ppm.) had got depressing effect as the growth of plants was retarded and dry matter content was reduced (Photo Plate II and Table III). The same effect was observed at 40 days of growth and observations at the age of 60 days also confirm the above findings.

A perusal of data, regading dry matter content in leaves, roots and bulbs, recorded in Table IV explains the result. Lower concentration (1 ppm.) of NAA and IBA both, had accumulated more dry matter than control, while stronger dosage (100 ppm.) had inhilated the growth, hence dry weight was reduced to considerable extent. The medium dosage (10 ppm) had also given encouraging effects but to a lesser degree.

The effect of the treatment with plant regulating substances followed approximately the same trend in later part of the growth period. A perusal of the data at 40 and 60 days of growth further confirms the statement.

TABLE III. *Effect of seedling treatment with NAA and IBA on the dry weight of onion plants at different stages of life cycle; duration of treatment 8 hours; 3 replications; average of 5 plants in each replication.*

Treatments		Dry weight of the plant in Mgms at the age of		
		20 days	40 days	60 days
Control		127.00	161.33	244.00
NAA	1 ppm.	180.00	250.00	343.33
NAA	10 ppm.	166.00	198.66	280.33
NAA	100 ppm.	102.00	140.33	183.66
IBA	1 ppm.	186.00	271.33	385.00
IBA	10 ppm.	160.00	202.66	312.66
IBA	100 ppm.	106.09	141.66	193.33
'F' Value		50.95*	210.97*	133.73*
C.D. Value at 5% level		15.04	11.09	21.36

*Significant at 1% level.

TABLE IV. *Effect of seedling treatment with NAA and IBA on the dry matter content in leaves, roots and bulbs of onion plant at different stages of life cycle; duration of treatment 8 hours; 3 replications; average of 5 plants in each replication.*

Treatments		Mean dry weight of leaves (Mgms) at the age of			Mean dry weight of roots (Mgms) at the age of			Mean dry weight of bulbs (Mgms) at the age of		
		20 days	40 days	60 days	20 days	40 days	60 days	20 days	40 days	60 days
Control.		76.66	89.66	101.66	16.00	30.00	45.33	30.00	41.66	97.00
	1 ppm.	120.00	151.66	150.00	22.00	45.00	68.33	40.00	53.33	138.33
NAA	10 ppm.	104.00	114.66	113.00	22.00	39.33	49.66	38.00	45.00	117.66
NAA	100 ppm.	70.00	81.33	77.66	10.00	25.66	32.66	22.00	33.33	73.33
IBA	1 ppm.	122.00	163.33	161.66	24.00	50.00	65.00	40.00	58.00	155.00
IBA	10 ppm.	106.00	118.66	129.00	20.00	37.66	52.33	34.00	46.33	131.33
IBA	100 ppm.	70.00	83.66	80.00	10.00	27.33	32.66	24.00	30.66	80.66
'F' Value		53.52*	269.77*	247.24*	15.48*	60.15*	75.93*	42.80*	30.45*	99.10*
C.D. Value at 5% level.		9.63	6.18	6.29	4.55	3.27	4.46	3.48	5.51	9.41

*Significant at 1% level.

DISCUSSION

From the observations recorded on treated lots of plants in the present experiment, it seems abundantly clear that low concentration dosage of both indole and naphthalene compounds proved to be stimulative while stronger dosages were detrimental. Weaker solutions of NAA and IBA both enhanced the growth and thus accumulated more dry matter in the plant. On the other hand stronger dosage retarded the growth of plants hence dry matter cotent in leaves, bulbs and roots was much reduced (Photographs I and II and Tables I to IV). This was probably due to the stimulative effects of growth regulators on plants in lower concentrations and toxic effects of the same at higher concentrations (Chaudhary, 1954; Garg, 1959 and Vaish, 1954). The observations recorded in the present study are in lieu what has been recorded by Tang and Loo (1940), Swarts (1941), Bonner (1949), Rhodes *et al* (1950), Isenberg *et al* (1954), Asana *et al* (1955) and many others on a number of species of plants.

In this investigation two types of treatments, i.e., seed and seedling treatments were used and their effects on dry matter production in leaves, bulbs and roots of onion were studied. On the basis of data recorded in the investiagation it may be concluded that generally plants which were subjected to seedling treatment produced more dry matter as compared to the plants belonging to the series of seed treatment. It is a well-known fact that at seed stage the tissues are not well differentiated and they are rather in an embryonic stage. Moreover, onion belongs to monocot group of plants which have comparatively weakly differentiated tissues. It is just possible that penetration of hormonal compounds created a sharp increase in metabolism of the seeds which could not keep pace with the developing tissues and this might have disturbed the whole physiological balance of the young seedlings. It, therefore, seems feasible that a setback in the early stage of the plant life created some discouraging after-effects in the form of lesser growth and development resulting in the less accumulation of dry matter in the later life of the plant. On the other hand, as already mentioned earlier, the seedling treatment, which involved the treatment of onion seedling roots, consists of more differentiated tissues as compared to the tissues found in seeds. It is, therefore, logical to believe that such differentiated tissues could withstand the high reactions carried by a auxins and produced more dry matter.

It is evident from the data recorded in Table III that the effects of NAA and IBA were not identical. There was significant difference between the two. Plants treated with IBA had accumulated more dry matter than those treated with NAA. It is difficult to explain the efficiency of one over the other but it may be assumed that this may be due to fascinating relation between chemical structure and activity of the auxin. Indole compounds preferably with a butyric-side-chain have proved useful towards root formation in the investigations of Audus (1949), Linser (1951) and Norman and Weintraub (1951). It induced a type of root system which is qualitatively better than induced by other hormonal compound. Success of this compound may be because its auxin activity is weak and it is slowly destroyed by auxin-destroying enzyme system. As also observed in this experiment that naphthalene-acetic acid had shown better responses than the control, but with less uniform success. It

seems so because of the fact that NAA is quite a strong auxin as compared to the IBA. It has also been observed that strong auxins usually inhibit bud and root development (Leopold, 1960). Besides these, IBA is more soluble and has, therefore, more rapid penetration into the tissues (Hitchcock and Zimmerman, 1938). The stimulatory activity of IBA on root growth caused better rooting, (Photograph II) which increased the absorptive capacity of the plant due to increased metabolism and better translocation resulting in storage of more food and dry matter in the plant parts.

SUMMARY

Two experiments were planned on field scale to study the effect of seed and seedling treatment in aqueous solutions of NAA and IBA on the dry matter production of onion. The dosage concentrations were 1, 10 and 100 ppm. The plant regulators used, i.e., NAA and IBA were not identical in their effects.

In general, lower and medium dosage, concentrations of 1 and 10 ppm. caused accelerating influences whereas the higher dosage of 100 ppm. were invariably toxic. Different types of treatment, i.e., seed and seedling treatments, showed unidentical effects. IBA at 1 ppm. in seedling treatment and at 10 ppm. in seed treatment induced dominating responses.

ACKNOWLEDGMENTS

Author is grateful to Dr. O. K. Garg for technical supervision and to Prof. B. Prasad, Head of the Department of Botany, Jat Vedic College, Baraut (Meerut), U.P., for providing facilities and encouragement during the investigation period.

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Weed Control in Potatoes with Pre-plant and Pre-emergence Herbicides

P. N. PANDE[1] and A. K. GHOSH[2]

The present paper is a continuation of the work started in 1964-65(4). The results amply justify the need for weed control in potatoes. Work done by others on the use of herbicides in potatoes has been also reviewed earlier (4). Further reports on the use of dimethyl 2, 3, 5, 6-tetrachloroterephthalate (Dacthal), at the rate of 8 lb (spray) and 24 lb (gramules), show good and excellent weed control respectively of *Digitaria* sp., *Amaranthus retroflexus* and *Chenopodeum album*, and increase in the yield of potato (3).

METHODS AND MATERIALS

The yield differences of potatoes due to different weed control treatments were not significant in 1964-65 in spite of excellent weed control in certain treatments (4). This has been explained to poor weed stand in all the plots. In order to ensure a proper weed stand, weed seeds, particularly that of Pathri (*Trianthema monogyna*) were uniformly scattered over the field at the time of field preparation.

The experiment was laid out in a randomised complete block design with four replications. The net plot size was 7 ft. by 32 ft. The treatments included pre-emergence application of 2, 4-dichlorophenyl, 4-nitrophenyl ether (Tok E-25) at 4 and 8 lb (a.i.)/A., Dacthal at 7 and 14 lb (a.i.)/A., pre-plant application of Ethyl di-n-propyl thiolcarbamate (EPTC) and propyl ethyl-n-butyl thiolcarbamate (PEBC) at 4 and 8 lb (a.e.)/A. along with weeded and unweeded control treatments.

Planting of tubers (Var. K 122) was done on October 23, 1965. The method of planting and of herbicide application were the same as in the previous year. However, Dacthal was not incorporated into the soil. Interculture in all plots followed by ridging was done 32 days after planting. Weeding was done in the weeded control(T_1)plots with hand tools (khurpi) prior to interculture and earthing.

Observations were taken at three places in each plot on the average number, composition, and dry weight of weeds, per 0.25 sq. meter, 30 and 94 days after planting. At the time of harvest of potatoes, fresh weight of weeds from each plot was recorded. Observations were also taken on the stand of potatoes (4 meter length samples per plot), deformity symptoms, dry weight per plant, yield of tubers and relative proportions of the different size group of tubers. The tubers from each plot were sorted into three groups, viz., large (over 1.5 inch dia.),medium (1.0 to 1.5 inch dia.), and small (below 1.0 inch dia.), and the weight recorded.

RESULTS AND DISCUSSION

Stand of potato plants, on the basis of observation taken 45 days after planting, was found to be uniform in all the plots. However injury symptoms on some potato plants were observed in the plots treated with Dacthal, EPTC and PEBC. Plants in the EPTC and PEBC treated plots recovered after about a week.

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Effect on Weeds: A visual observation 12 days after planting showed marked difference in weed stand in the different treatments. Unweeded control plots showed the most severe weed infestation. A qualitative rating of weeds was possible only 20 days after planting (Table 1). The weed intensity in untreated plots was 4 to 8 times heavier than the plots treated with herbicides.

Observations on the average number, composition and dry weight of weeds taken 30 days after planting are given in Table 1. The data shows a significant reduction in the weed stand due to the use of different herbicides as compared to the untreated plots (Fig. 1). Best weed control was obtained from the 8 lb rate of Tok which was significantly superior to 4 lb rate of EPTC and the two rates PEBC. In general, higher rates of the herbicides were more effective than the lower rates.

Bathua (*Chenopodium album*) was the most predominant weed present, followed by Pathri, Clovers, Motha (*Cyperus rotundus*) and other weeds (Table 1). The number of Motha present was negligible in comparison to the broadleaf weed species, contrary to the species composition reported in the previous work of 1964-65.(4) In general, all the herbicides provided an effective control of broadleaf weeds.

TABLE 1. *Average Number, Species Composition and dry weight of weeds.*

Treatments	Weed intensity per plot 20 days after planting [1*]	Av. No. of weeds per Sq. Meter 30 days after planting[2*]	Composition per Sq. Meter 30 days after planting [3*]					Av. dry weight of weed per Sq. Meter 30 days after planting (in gms.)
			1	2	3	4	5	
T_0—Unweeded Control	0	1195	16	643	293	129	114	81.15
T_1—Weeded Control	9	1201	27	636	329	123	85	79.20
T_2—Tok 4 lb/a.	1.5	189	18	90	20	48	14	10.10
T_3—Tok 8 ,, ,,	1.5	99	6	48	12	22	10	5.50
T_4—EPTC 4 ,, ,,	3	639	2	352	121	123	41	21.10
T_5—EPTC 8 ,, ,,	1.5	195	2	73	36	65	20	3.25
T_6—PEBC 4 ,, ,,	1.7	634	10	439	117	49	18	25.35
T_7—PEBC 8 ,, ,,	1.0	394	1	274	33	75	12	4.70
T_8—Dacthal 7 lb/a.	1.5	219	3	5	8	167	35	2.85
T_9—Dacthal 14 ,, ,,	0.7	147	11	1	17	105	13	2.55
C. D. at 5%		379.84						31.24

*1. Visual observation rated from 1 to 10 in ascending order of magnitude.

*2. No hand weeding was done in the plots receiving the T_1 (weeded control) treatment till the specified period, i.e., 30 days after planting.

*3. (1) *Cyperus rotundus* (Motha) (2) *Chenopodium album* (Bathua) (3) *Trianthema monogyna* (Pathri) (4) *Medicago* spp. (5) Miscellaneous—*Vicia hirsuta* (Akra)—*Anagallis arvensis* (Krishnaneel), *Asphodelus tenuifolius* (Pyazi), *Solanum nigrum* (Makoya), etc.

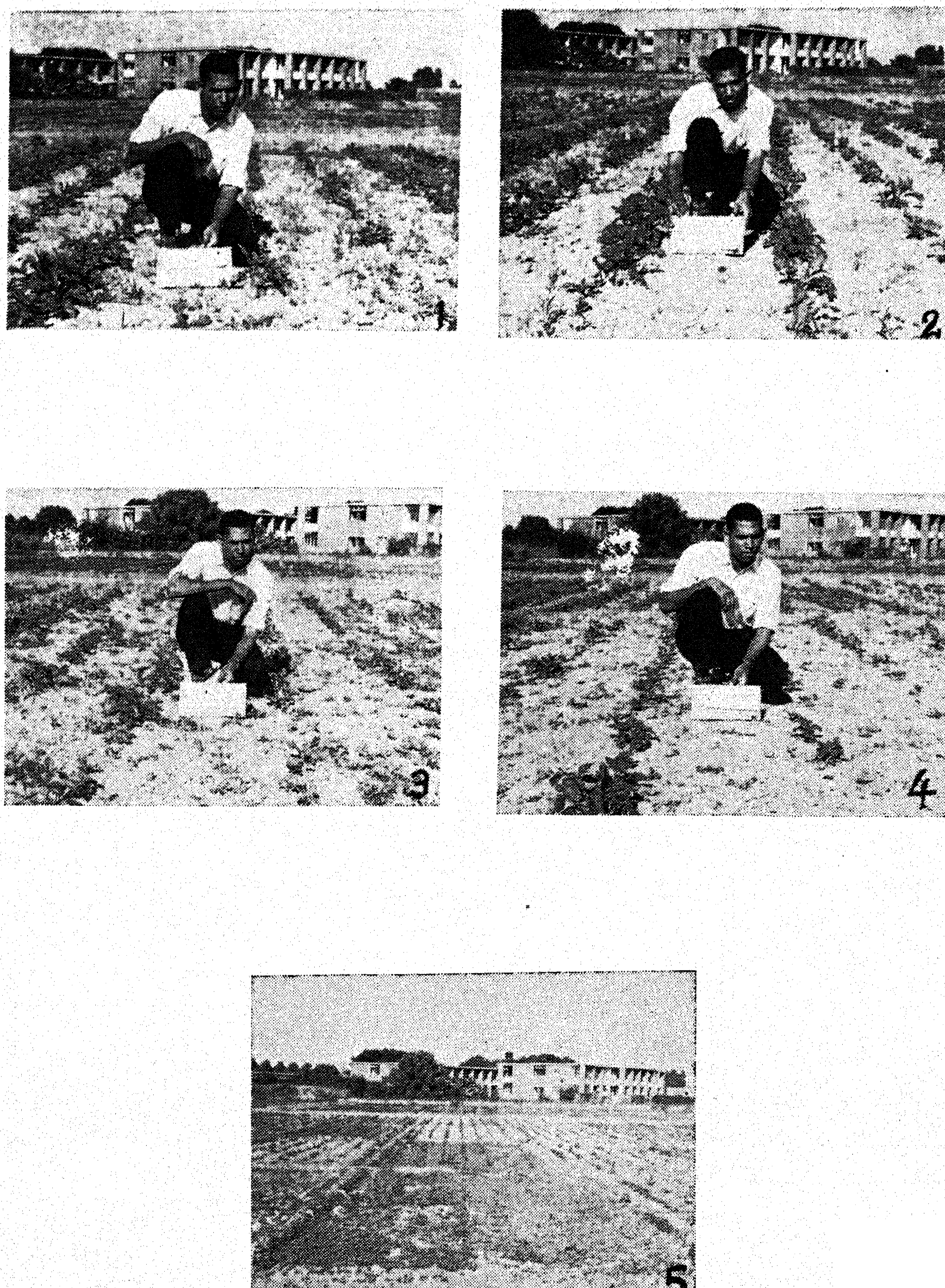

Fig. 1. Weed control in potatoes as obtained through different treatments (For details see footnote on page 222).

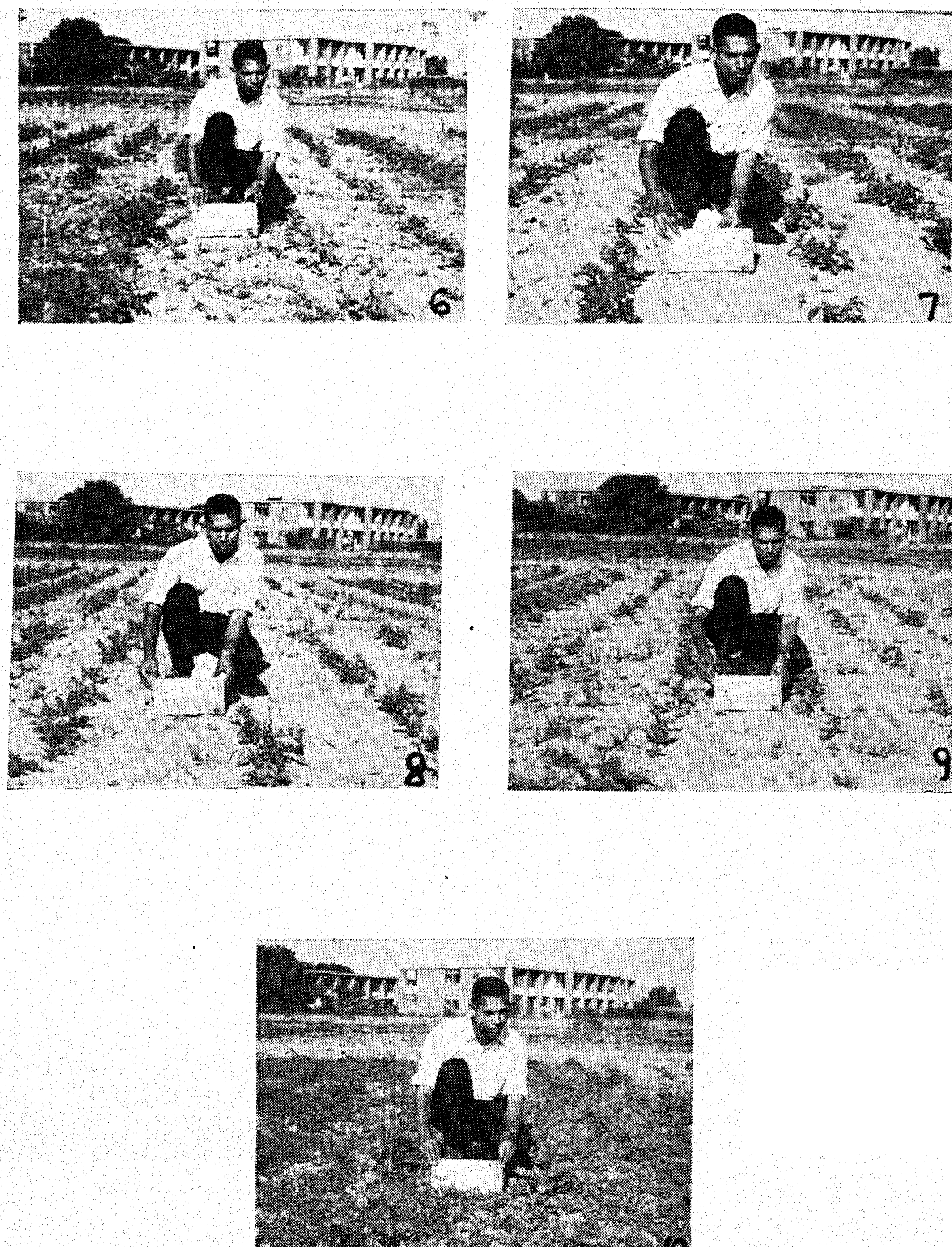

Fig. 1. (Contd.) Weed control in potatoes as obtained through different treatments (For details see footnote on page 222).

The dry weight of weeds under different treatments followed the same trend as observed in case of average number per meter.

The hand weeding in the weeded control plots was done one month after planting.

A second reading on weed infestation taken 94 days after planting showed no significant difference between treatments (Table 2). This shows that fresh weed emergence had taken place between the first and second readings. The number of weeds in the untreated plots was lower than that observed in the treated plots showing that fresh emergence of weeds were checked by the established weeds in the former. Apparently the herbicides did not remain effective till this stage. Observation on the dry weight of weeds per sq. meter showed that weight did not increase with fresh weed infestation (Table 2). Thus, the dry weight of weeds (per sq. meter) in the treated plots remained significantly low, although the number of weeds had considerably increased compared to the unweeded control plots. There are no reports to show the duration of effectiveness of Tok, EPTC and PEBC. In the present study they were

TABLE 2.—*Average dry weight per plant, number of weeds, species composition and dry weight of weeds per sq. meter.*

Treatments	Av. dry weight per plant (gms) 60 days after planting	Av. No. of weeds per sq. meter 94 days after planting	Composition per sq. meter 94 days after planting*1						Dry weight of weeds per Sq. meter 94 days after planting (in gms)
			(1)	(2)	(3)	(4)	(5)	(6)	
T_0—Unweeded Control ..	7.7	257	5	104	14	68	59	6	545.1
T_1—Weeded Control ..	10.1	395	12	180	0	99	91	12	112.5
T_2—Tok 4 lb/a. ..	19.7	203	10	67	1	50	59	16	154.0
T_3—Tok 8 „ „ ..	20.3	298	5	170	0	75	25	21	76.3
T_4—EPTC 4 „ „ ..	18.0	442	5	178	7	106	130	15	192.7
T_5—EPTC 8 „ „ ..	17.6	396	1	177	0	161	43	12	34.9
T_6—PEBC 4 „ „ ..	13.9	340	3	194	1	83	46	12	187.1
T_7—PEBC 8 „ „ ..	21.6	499	7	237	0	121	120	15	32.3
T_8—Dacthal 7 lb/a ..	24.4	294	1	81	0	133	66	13	34.0
T_9—Dacthal 14 „ „ ..	17.5	145	7	48	0	75	8	7	18.5
C. D. at 5% ..	Not significant	Not sig.	..	..	..	..	..	..	103.16

*1(1) *Cyperus rotundus* (Motha)
(2) *Chenopodium album* (Bathua)
(3) *Trianthema monogyna* (Pathri)
(4) *Medicago* spp. (clovers)
(5) *Anagallis arvensis* (krishnaneel)
(6) Miscellaneous—*Vicia hirsuta* (Akra), *Asphodelus tenuifolius* (Piyazi), *Spergula arvensis* (satgathia), *Convolvulus arvensis* (Hirankhuri).

fairly effective for a period of 30 to 45 days after application. Dacthal has been reported to control weeds for 3 weeks (1). However, such secondary infestation do not appear to affect the yield of tubers (4).

Fresh weight of weeds (Table 3) from the treated plots was significantly lower than the untreated check. The two rates of Dacthal and 8 lb rate of PEBC provided a significantly lower fresh weight than the weeded control tratment. However, best weed control was obtained from the 14 lb rate of Dacthal, the weight of weeds being 13.50 Qts./ha. The higher rates provided a better weed control than the lower rates although the differences were not significant.

TABLE 3. *Fresh weight of weeds at harvest, yield of potato tubers and relative tuber size*

Treatments	Fresh weight of weeds in Qts./hect.	Yield of potato tubers in Qts./hect.	Relative tuber size expressed in per cent of total yield/treatment		
			Large	Medium	Small
T_0—Unweeded Control	241.32	52.47	21.8	39.0	39.2
T_1—Weed Control	90.05	130.22	36.8	28.3	33.1
T_2—Tok 4 lb/a.	102.82	156.97	39.3	30.8	29.9
T_3—Tok 8 lb/a.	54.80	156.97	34.3	40.9	24.8
T_4—EPTC 4 lb/a.	94.90	112.15	31.8	36.2	38.7
T_5—EPTC 8 lb/a.	30.50	149.67	42.1	32.7	25.2
T_6—PEBC 4 lb/a.	83.60	127.80	35.5	35.0	29.5
T_7—PEBC 8 lb/a.	46.92	143.85	39.6	36.7	23.7
T_8—Dacthal 7 lb/a.	27.50	124.40	43.9	31.7	24.4
T_9—Dacthal 14 lb/a.	13.50	104.47	42.4	30.8	26.8
C.D. at 5%	57.72	50.05	..	..	..

*Size of tubers: 1. Large Over 1½″ Diameter, 2. Medium 1″ to 1½″ Diameter, 3. Small Below 1″ Diameter.

Effect on the growth of potato plants: Dry weight of plants was used as a measure of growth. Dry weight (per plant) recorded 60 days after planting is shown in Table 2. While the differences in dry weight of plants due to treatments were not significant, the weight per plant from

Captions for Fig. 1

1. TOK E—25 4 lb/A.
2. TOK E—25 8 lb/A.
3. EPTC 4 lb/A.
4. EPTC 8 lb/A.
5. General views of the experiment. The untreated plots or are full of weeds.
6. PEBC 4 lb/A.
7. PEBC 8 lb/A.
8. Dacthal 7 lb/A.
9. Dacthal 14 lb/A.
10. Unweeded Control plot.

herbicide treated plots were twice that from no weeding. The plants in the weeded control plots also had a higher dry weight than the plants in untreated check.

Effect on the tuber yield: Potato tubers were harvested on Feb. 1, 1966. An abnormal behaviour of the plants in the tuber formation was observed in the Dacthal treated plots (2). All the herbicide treatments (T_2 to T_9) along with weeded control (T_1) gave significantly higher yield than unweeded control (T_0). There was no significant difference between the weed control treatments, except between the 14 lb rate of Dacthal (104.47 Qt./ha.) and the two rates of Tok (156.97 Qt./ha.). Yield reduction in case of higher rate of Dacthal was due to injury to the crop as stated earlier. The extent of yield increase due to weed control, in general, was 155.4 per cent. Higher yield of tubers over weeded control treatment were obtained only from 4 and 8 lb rates of Tok (156.97 Qt. per hect.) and 8 lb rates of EPTC and PEBC (149.67 and 143.85 Qt. per hect.)

Differences in the rates of herbicides used had no significant effect on yield of tubers although higher rates apparently resulted in better yields. The higher yield from treated plots may be attributed to the reduced weed competition resulting from either the use of herbicides or hand weeding.

Effect on the size of tubers: There may be some influence of weed control treatments on the relative percentage of tuber size. Relative percentage of tubers sorted out into three groups (large, medium and small) from each treatment are presented in Table 3. While major portion of the tuber yield obtained in the unweeded check plots comprised of medium and small size tubers, majority of the tubers fell in the large and medium size groups in the treated plots. Best results were obtained from the 8 lb rate of PEBC and 7 lb rate of Dacthal where 42.1 and 39.9 per cent of tubers were of large size, the per cent of small size being only 25.2 and 24.4 respectively.

SUMMARY

Application of all the four herbicides, Tok E-25, EPTC, PEBC and Dacthal was found to provide effective control of weeds in potato. Higher rates of herbicides provided a better weed control although the differences were not significant. Application of Dacthal at 14 lb rate injured the crop resulting in abnormal tuber formations. The different weed control treatments used resulted in a higher yield than unweeded control. Higher yield of tubers, than that from the weeded control treatment, was obtained from 4 and 8 lb rates of Tok and 8 lb rate of EPTC and PEBC. Difference in the yield due to application of lower and higher rates was not significant although higher rate resulted in better yields. The extent of yield increase due to weed control, in general, was 155.4 per cent. Application of 8 lb rate of PEBC and 7 lb rate of Dacthal had the best influence on the size of tubers.

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Technical News

SOME PROMISING FORAGE LEGUMES

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In India the livestock population per unit area is tremendously high. The grasses and legumes, predominating our natural vegetation, are mostly of impoverished type and they do not respond to improved management practices. In the local herbaceous flora the perennial herbaceous legumes, *viz. Desmodium parvifolium, Indigofera linifolia, Crotolaria medicaginea, Rhynchosia minima*, etc, do not contribute much in our pasture yields.

To introduce some high yielding legumes in our pasture we imported from the Division of Tropical pastures (C.S.I.R.O., Queensland), a number of legumes, *viz: Desmodium intortum* (C.P.I. 18009), *Desmodium uncinatum* (C.P.I. 8990), *Desmodium sandwicense* (C.P.I. 11740), *Dolichos axillaris* (C.P.I. 17814), *Glycine javanica* (C.P.I. 17673 and 25702; C.Q. 363), *Leucaena glavca* ver. Peru (C.P.I. 18614), *Lotononis bainessii* (C.P.I. 16833), *Phaseolus atropurpureus* (C.P.I. 16879 and 18556; C.Q. 364), *Phaseolus lathyroides, Stylosanthes gracilis* (Fine stem C.P.I. 11493) and *Stylosanthes humilis*.)

These were grown in small plots (4.5 × 2.4 m) at Kanke in sandy loam red soils of pH 6.5, under rainfed condition. Observations on growth habits, flowering, persistency, bulk of herbage, etc, were recorded for 3 successive years (1962-65).

Stylosanthes humilis: Although annual it gave the best performance. Its establishment from seeds was good. It produced seeds in plenty and appeared to be aggressive. Even after collection of seeds, its regeneration from the seeds left over was superb. It was least competed with other weeds. When cut in August it produces a fair amount of regrowth in October. Its green herbage yield is about 70-100 q/ha. Due to its persistency through seeds, aggressive nature and easy establishment, a number of other experiments have been designed to study its compatibility with other grasses.

Phaseolus atropurpureus: Amongst the perennial legumes its growth had been the best, particularly of the variety C.Q. 364. It could trail over the ground, pegging roots at nodes. It was summer growing and with the onset of ground frosts its growth ceased, to rejuvenate again in March. It produced seeds in plenty. It is persistent and yielded about 80 q/ha/annum. With its twining stems it competed with grasses well during rains.

Dolichos axillaris: This perennial legume was least harmed by ground frosts. It flowered in late December and February. It did not grow very prolific during rains but it remained very green under dry conditions. It produced seeds in plenty. When cut once during rains a number of plants died. Its persistency under frequent cutting is still to be observed.

Leucaena glauca: A low growing shrub showed beautiful growth and produced seeds prolificly. Lopping of the branches once a year did not damage the plants. The legume

having 19% protein in their leaves appeared to be of great importance to be sown as hedges on the soil conservation contour bunds to provide forage in lean months.

Lotononis bainessii: This perennial legume of trailing growth habit with roots at the nodes could not compete well with the grasses during rains. In spring it produced a large number of flower heads and seeds. Due to its poor competitive habit it could not persist well. It was very specific in its *Rhizobium* requirement.

Glycine javanica: It was very slow in establishment. It took 2 years (when a number of hand weedings were given) to have a good stand of the legume. The performance of the variety C.Q. 363 was the best. It produced seeds but its seeds production was affected by the early incidences of ground frosts.

Desmodium varieties: They did not persist long. They produced seeds. The performance of *Desmodium uncinatum* was better than the other.

The growth of *Phaseolus lathyroides* was not as much vigorous as some of other annual legumes (*Phaseolus aureus* and *Phaseolus calcaratus*). The performance of the thin stem variety of *Stylesanthes gracilia* was also not as much vigorous as of our own variety.

MYRDAL SAYS LAND REFORM URGENT FOR SURVIVAL

Rome, 20 June—Radical land reform is an urgent matter for survival in under-developed countries, in face of a hunger crisis and population "explosion" which may have repercussions on the security of the wealthier nations as well, Prof. Gunnar Myrdal, noted Swedish economist, declared in a speech prepared for delivery on today's opening of a World Land Reform Conference here.

The world's true proletariat are the agricultural workers in those countries, he said. They included the landless labourers, sharecroppers, most other tenants, and even the majority of peasants who owned tiny plots of land.

The Rome conference, organized jointly by the United Nations and the Food and Agriculture Organization (FAO), is meeting here through 2 July.

At the same time, Professor Myrdal said, it had been generally agreed that no type of ownership and tenancy of land can be totally beneficial unless combined with policy efforts in other fields, such as marketing, farm credit, extension services, and improved education of both children and adults.

In addition to a tendency of "increasing economic inequality" in most under-developed countries, he listed three "powerful and threatening trends of change under way" that were making "radical land reform, geared to the goal of raising productivity in agriculture, an urgent matter of survival."

One such trend was the rapid and accelerating population growth in all under-developed countries. The only hope of changing this trend was the spread of birth control among the masses, he said.

A second was the slowing down of economic growth in the developing countries, particularly in agriculture. Food production per head of population in most of those countries was now lower than before the Second World War.

A third trend, he added, was the "levelling off aid, and, indeed, the total capital flow from the rich to the under-developed countries." In real terms, grants, credits and direct investments had recently rather tended to decrease, with the exception of food aid Prof. Myrdal warned:

"Together, these three trends of change are creating an exceedingly and unprecedentedly dangerous world situation with the life and social order at stake for the huge majority of people in most under-developed countries, and with consequences for international relations which menace also the security and welfare of the rich nations. The approaching hunger crisis is, more particularly, the serious challenge to this conference."

He added: "The 10 or 15 years of immediate danger are those right ahead of us."

To avert "world calamity," the yields of land must be substantially raised in this period.

Prof. Myrdal said there was truth in the assertion "so often made by intellectual and political leaders in under-developed countries that what is needed is an economic and social revolution."

"The practical problem is whether their realization of this need can overcome the tremendous inertia and resistance, backed by vested interests, in their countries.

"We know that while there have been many political coups in many under-developed countries, there has been little of fundamental economic and social change. It is a serious thing that, generally speaking, the only major economic and social change in the under-developed world up till now has been the population explosion."

But Professor Myrdal concluded on a note of hope. "The whole world—both the rich, developed, and the poor, under-developed nations—will be forced into a companionship to feed the hungry and to raise the yields in the under-developed countries. . . . "

"Not only grains but ideas will move over national boundaries. . . Out of this intensified, all-embracing communication of ideas can emerge an increased preparedness for rapid and radical economic and social reform in the under-developed countries, and in the developed countries for really substantial participation and aid."

I/R/Press 66/90 WLR/2, Food and Agriculture Organization of the United Nations, Rome.

NEED FOR JUSTICE IN LAND REFORM PROGRAMMES

Rome, 20 June—(EMBARGO)—Land reform as an aid to general economic and social progress in developing countries was examined by Prof. D. G. Karve, adviser to the Reserve Bank of India, in a speech prepared for delivery today at the opening of a World Land Reform Conference.

The conference was called by the United Nations and the Food and Agriculture Organization (FAO), with the participation of the International Labour Organization.

Professor Karve listed three "basic principles which underlie any constructive or developmental approach towards land reform." They were:

1. "An awareness of the justice of providing equal opportunities to all to improve their lot by their own effort."

2. "An overall responsibility for securing for all classes a standard of welfare commensurate with the stage of the progress of the national economy."

3. "A readiness to support by active public assistance all efforts of individuals which are calculated to improve their own lot and contribute to the progress of the nation."

Prof. Karve said a land reform programme which had stopped half-way, or had been half-heartedly undertaken, "almost inevitably creates conditions which are inimical to justice as well as to development."

Land reform, he said, was justified "as the first step in the strategy of national economic development in countries, especially in thickly-populated countries, which have set them selves the tasks of ensuring at the earliest possible date full employment and rising welfare for their people."

There was an "inescapable unity of interest as well as of mutual dependence between agriculture and the rest of the economy which deserves to be emphasized more frequently than is usually done in discussion about land reform and its implementation."

I/R/Press 66/91 WLR/3, Food and Agriculture Organization of the United Nations, Rome.

MINISTER RESTIVO STRESSES HUMAN NEEDS IN LAND REFORM

Rome, 20 June—Land reform must be governed by an overall guideline which integrates the redistribution of land with a set of measures aimed at raising the living standards of peasants, Mr. Franceo Restivo, Italian Minister of Agriculure, told the World Land Reform Conference here today.

The conference was called by the United Nations and the Food and Agriculture Organization, with the co-operation of the International Labour Organization.

The infrastructure of a land reform includes the building of roads, schools, aqueducts, power liyes, farm houses and sables, the Minister pointed out. It includes irrigation systems, farm credit, technical assistance, as well as rural co-operatives.

Mr. Restivo said these different directives must follow a "unified view" of the problem.

Experience gained in the past 20 years by various countries in this field provided the conference with a precious contribution to its study, he declared.

He said Italy had carried out a land reform after the Second World War which was "constantly concentrated on man." His spiritual and human betterment was its final objective together with the aim of wider well-being.

Mr. Restivo added: "Agrarian reforms have been realized and are in progress in several other countries. May I be permitted to say that in no experience ought there to be lacking the constant inspiration of making the peasants the protagonists of this work in building a higher rural civilization."

I/R/Press 66/96 WLR/5, Food and Agriculture Organization of the United Nations, Rome.

WORLD-WIDE STANDARD FOR CHEESE

Rome, 24 June—Cheese experts from 25 countries and seven international organizations have approved a series of international individual standards for such well-known cheeses as Cheddar, Gouda, Edam, Dambo, Havarti, Samsoe and Danablu for submission to Governments for acceptance.

The meeting was the 9th Session of the Joint FAO/WHO Committee of government experts on the code of principles concerning milk and milk products. It met this week under the chairmanship of Prof. A. M. Guerault (France), assisted by vice-chairmen J. L. Servais (Belgium) and H. Metz (Denmark).

The standards include the designation of the chesse, the country of origin, the other countries where it is manufactured, the characteristics of the cheese, manufacturing process, the sampling techniques, marketing and labelling.

Elements of the code of principles have now been accepted by 71 governments.

The standards are aimed at protecting consumers against adulteration or deception, ensuring fair trade practices and eliminating indirect barriers to trade.

Acceptance of such standards by Government implies that these Governments will not hinder, within their territorial jurisdiction, the distribution of food which conforms to the international standards, FAO officials said.

I/R/Press 66/101, Food and Agriculture Organization of the United Nations, Rome.

ASK POOL OF YOUNG EXPERTS TO AID LAND REFORM

Rome, 28 June—An international pool of young experts to help developing countries carry out land reform was suggested here yesterday by a Kenyan participant in the World Land Reform Conference.

Mr. J. Maina, Director of Land Settlement, proposed to a working group of the conference that the Food and Agriculture Organization or other international agencies form a pool of suitably-selected young people prepared to spend two or three years in a developing country.

While Kenya needed "high-powered" advisers to aid in agricultural planning, he explained, it could also use the young people as personnel for agricultural training schemes. He cited the example of the United States Peace Corps.

The conference, which is meeting through July 2, was discussing the special training needed to equip administrators and technicians for their responsibilities in land-reform and settlement programmes.

A participant from the Union of Soviet Socialist Republics said his country was ready to share its experience in land reform. He sugested that the United Nations, co-sponsor with FAO of the conference, hold seminars in the Soviet Union, and that Soviet experts be loaned to countries needing advice and training.

I/R/Press 66/102 WLR/8, Food and Agriculture Organization of the United Nations, Rome.

FARMER AND THE LAND

—Land Reform Conference Ends—

Rome, 2 July—Man's right to own and to earn from the land he tills was affirmed today by the World Land Reform Conference.

The conference ended a two-week scrutiny of the relationship between the farmer and his land. The basic question was how to make this fundamental association more effective—in producing more food, improving the farmer's life and income, bettering his community, and in contributing to the economic growth of his country.

The meeting, first such held since a smaller one in 1951, was convened by the United Nations and the Food and Agriculture Organization, with the co-operation of the International Labour Organization. To it came some 300 officials, experts and consultants from 77 countries and territories; they were nominated either by their governments or by the sponsoring organizations.

The chairman, Dr. Hernan Santa Cruz of Chile, warned the closing session that world peace might be threatened if hunger and extreme social inequality were not righted. Dr. Santa Cruz, who is FAO's Assistant Director-General for Latin America, said that if effective action was not taken soon to alleviate the "conditions of existing and impending hunger and extreme social inequality within and between nations, we may witness a cataclysmic social disruption in many parts of the world during the coming years, and the very peace of the world may be threatened."

In a resolution adopted unanimously, the conference called for further studies of land reform problems on a regional basis. It asked the developed nations to extend adequate technical and economic assistance in land reform and related fields, and urged exchanges of experts and trainees in agrarian reform. The resolution also recommended that the U.N. and FAO continue to provide assistance to countries in planning and carrying out land reform.

Commenting on the results of the conference, Dr. Santa Cruz said it had generally agreed that the traditional agrarian structure had proved incompatible with rapid economic and social progress.

"The old structure placed almost all resources in the hands of minorities, granting them virtually the only opportunities for progress," he said. "These minorities have, naturally, shown little inclination to accept changes, since they already enjoy the best that society can offer in the way of prestige, wealth, and power.

"This is the reason that land reform has come to be identified with economic and social development," he said.

The conference's rapporteur, Mr. J. A. C. Davies of Sierra Leone, said its discussions had succeeded in high-lighting the fact that "land ultimately remains the key issue of economic development."

From them had emerged a number of points of focus and "a great extent of agreement." Among these, he said, the most important was the realization that land reform should not be seen in isolation but as a part of overall development planning. Economic and social factors should define the type of land reform to be implemented in any particular country, be it individual ownership or collective farming. Even the co-existence of various tenure types within one country was possible and often desirable.

But, he emphasized, no tenure system must be allowed to violate human dignity; the objective of a real land reform could be reached only if all feudal or semi-feudal tenures were abolished and if a new tenure system provided sufficient incentives for the cultivators. This was only possible if the structural policy prevented the continued existence of large landowners who dominate the institutional services organized by the government.

In opening the conference on 20 June, eminent speakers stressed the part which land reform could play in a world faced with a serious food crisis. Prof. Gunnar Myrdal, the Swedish economist, said such reform was "an urgent matter for survival" in the developing countries; the hunger crisis coupled with rising populations, he warned, could not only effect countries in direct need but could also have repercussions on the security of richer nations.

Dr. B. R. Sen, Director-General of FAO, termed land reform a "strong weapon" in the fight against hunger. The "veritable crisis" in the world food and agricultural situation, he said, called for a sustained world-wide effort aimed at an "agricultural revolution" in under-developed countries. This should be done, however, in a way which takes account of the need to increase human dignity.

Mr. Philippo do Seynes, U.N. Under-Secretary for Economic and Social Affairs, stressed the need to improve the technical and financial conditions of agricultural production while carrying out land reform; otherwise, he said, "effects may be negative and even temporarily catastrophic."

Other major speakers on opening day were Prof. D. G. Karve, Adviser to the Reserve Bank of India; the Italian Minister of Agriculture, Mr. Franco Restivo, and Mr. M. Osmay of ILO.

The sessions on the whole were largely technical, dealing with such subjects as how programmes of land reform or changes in land tenure could best be put into effect in, primarily, the developing countries. Participants explored each other's views on and experience of how best to initiate, regular, administer and finance land-reform schemes, and how to evaluate their results so that errors could be rectified and failures retrieved. They refrained from making recommendations to governments, but they arrived at general conclusions which will be transmitted to national authorities.

On the other hand, they did examine the wide variety of approaches to land, or statute-based, reform and to agrarian, or socio-economic, change. Many delegates felt that, between the massive documentation prepared on various national experiences, the discussion in working groups, and their encounters in the corridors and reception rooms, they had gained a valuable insight into who was trying which approach, and with what success.

The question before the conference was not whether land reform was necessary, but rather how to go about it in the most rewarding manner. How to turn this farmer into a landholder without leaving him dependent on his former landlord? How to provide him with the credit, techniques, machinery and education without which his new state could become a farce? How to help him enhance his dignity, to keep him in bad crop years from slipping back into the grip of the money lender, to help him educate his children yet convey to them a love for the land, to bring roads and water to where they will serve him, to strengthen his power to bargain in his own country and on international markets for fair prices?

These and many other human aspects of the broad problem were discussed by the delegates. They had found answers, either full or partial (and some had been negative) in systems ranging from the collective and state farms of the Union of Soviet Socialist Republics and Eastern European countries, through the predominantly free-enterprise systems of Western Europe, North and South America, to the attempts to use or convert the tribal, communal system of Africa to more modern usage.

A common thread ran through many of the technical discussions ranging as they did over questions of finance, administration, and methods of putting land-reform schemes into effect. It was the awareness that no plan could work without the help of the peasant farmer. He must feel that some person above suspicion is trying to do something that will benefit him. Motivation and incentive to the man who does the work were recognized as the elements without which the best plans could run aground.

Dr. Santa Cruz in his summing-up warned that action to improve the man-land relationship were disruptive.

"In a predominantly agricultural society, land redistribution entails a new sharing of wealth, social position and political power, inevitably producing irreversible changes in social structure."

Despite his "initial sombre predictions," he believed there were also important reasons for optimism, "assuming there is immediate remedial action."

"From now on we shall not be able to content ourselves merely with increasing production from land redistribution in the long run. We must, in addition, do everything possible to avoid short-run disruption and take measures rapidly to increase and diversify production, otherwise world food shortages will become even worse."

The conference had concluded that successful land reform must be part of a well-conceived overall plan for economic development.

Peasants and workers must be encourged to form co-operatives, trade unions and farmers' associations.

"The importance of the peasantry's full participation at all stages of the reform—its promotion, its organization and its execution—was vigorously emphasized by the conference participants," Dr. Santa Cruz said.

The conference also stressed the importance of supplying peasants with adequate credit technical assistance, and education.

He said: "Unquestionably, every effort should be made to provide such scarce and essential services rapidly, but to wait until they are fully available before undertaking structural reforms is tantamount to postponing development itself."

The Conference also brought out that land reform must be adapted to a country's needs. Dr. Santa Cruz said it would be "absurd to imagine that there are any standard procedures for carrying out land reforms or a single criterion for evaluating results."

Dr. Santa cruz also stressed international co-operation in agrarian reform. "The interrelation between the economic and social growth of the emerging world and the prosperity of industrialized nations and international peace cannot be doubted . . . It will be understood, then, that since agrarian reform is a factor vital to development, the international community must act with force and dynamism in order to assure its orderly realization."

"Everything should be done to prevent the social upheaval which destroys the national unity so necessary to the achievement of rapid development," he said.

"And the international community must demonstrate this co-operation through technical and financial assistance as well as helping to create an environment favourable to reform." I/R Press 66/110 food and agriculture organization of the united nations, Rome.

RICE MEETINGS IN LOUISIANA

Rome, 6 July—Three subsidiary bodies of the Food and Agriculture Organization's International Rice Commission, plus a new regional one, are to meet concurrently in Lake Charles, Louisiana, from 18-29 July.

The latter is the inaugural session of the Rice Committee for the Americas (28-30 July), while the former are technical working parties. The IRC itself meets in New Delhi, from 3-8 October to consider their recommendations.

The current year—1966 has been designated by FAO as "International Rice Year" to promote improvements in rice production and processing.

The first of the four bodies to meet—from 18-21 July—will be the working partly on soils, water and fertilizer practices. It deals with such matters as the water needs of rice under different irrigation methods, seepage control in paddy fields, and fertilizer needs, including investigations into the use of radioisotopes to help determine them.

The working party on engineering aspects of rice production, storage and processing will hold its fourth session from 21-25 July. Countries have been asked to report their findings on how harvesting, threshing and drying affect the milling quality of paddy.

The working party on rice production and protection will first meet jointly with the previous one to discuss insects and rodents attacking stored rice. It will afterwards review the major pests and diseases of growing rice. Finally the working party will also review genetic matters and seed production, certification and distribution.

The Rice Committee for the Americas is scheduled to meet from 28-30 July. The importance of rice as a staple food for the region's countries, and the status of rice production in each of them, will be discussed.

I/R/Press 66/110 Food and Agriculture Organization of the United Nations, Rome.

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THE ALLAHABAD FARMER

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Volume XL November, 1966 Number 6

CONTENTS

SERVE THE LAND ★ ALLAHABAD AGRICULTURAL INSTITUTE ★

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ALLAHABAD AGRICULTURAL INSTITUTE

ALLAHABAD, U.P.

Suggestion for Contributors to The Allahabad Farmer

Manuscripts dealing with all aspects of agriculture and rural life, eductional or research, are accepted for publication in *The Allahabad Farmer*. Manuscripts should ordinarily have more than purely local interest. Articles must be original material previously unpublished elsewhere. After review, each manuscript will be accepted for publication upon recommendation of the Managing Committee.

Manuscript. Two copies, one on bond paper, should be furnished for each manuscript. Double space everything—text, title, footnotes, literature cited, captions and tables (except in long tables). This is to provide space for clear marking for the printer. Number all pages consecutively. An additional copy of the manuscript should be retained by the author to ensure against loss.

Use as short a title as practical. Following the title give the author's name(s). It is desirable to divide the manuscript into sections with such headings as Methods and Materials, Results, Discussion, Summary, and Literature Cited. The order of items in the manuscript should be 1. Title and Author; 2. Text; 3. Summary; 4. Acknowledgment; 5. Literature Cited; 6. Tables; 7. Captions for figures; and 8. Figures.

Avoid underscoring headings, words or phrases unless they are to be printed in italics. Do not use solid capitals for titles. Measurements such as time, weight, and degrees should be in Arabic numerals regardless of the number of digits in the number. Where the figure is not one of measurement, figures below 10 should be spelled out except when one figure in a series has two digits, in which case all should be in Arabic. Scientific names of plants, chemicals, etc. or descriptions thereof should be given the first time used. Nomenclature, abbreviations, and definitions should follow standard references and those generally accepted for the purpose.

Footnotes. The title and address of the author(s) should be given as footnotes. Number footnotes to the text consecutively throughout the manuscript with superscript Arabic numerals. Designate footnotes to tables with superscript lower case letters.

Figures. Experimental data may be presented in graphic and tabular form, but the same data will not be presented in both forms. Photographs should be clear glossy prints and should be trimmed of unessential portions. Never use clips on photographs in any way. Graphs and drawings should be inked with heavy black lines to ensure clarity after reduction in size. Hand lettering should be large and clearly made preferably with a lettering guide; typing is not acceptable. Place the author's name on the back of each figure submitted. Type the legends for all figures on one sheet separate from the figures, in double space. Figures should be numbered consecutively in Arabic numerals.

Tables. Type each table double-spaced on a separate sheet. In long tables, the lines may be single-spaced, but the headings must be double spaced. Tables should be numbered consecutively in Arabic numerals in order of reference in the text. In tables, the caption, column headings, and side heading should be in lower case with only the first word and proper names capitalized. Avoid reporting non-significant decimal places in data.

Literature Cited. Citations are numbered alphabetically by senior author; the number of the reference is used in the text. Citations should include names of all authors, year of publication, complete title, publication, volume number, and inclusive pages, in that order. When there are two or more authors, put initials after the name of the first and before the name of others.

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ERRATA

The following may please be noted in the article "Lentil (Masur) by R. P. Singh and A. Aziz, published in "The Allahabad Farmer" Volume 40, No. 3, May, 1966.

Page 99, Table I, Item 6 read 273 instead 34 in column 3 and read 43 instead of 6 in column 4.

Add "Rajasthan in column 2 after No. 8 and insert 26 in column 3 and 5 in column 4 Delete" Ref. 1, 2, 3 as given at the bottom.

Page 102—Fourth line of para 1. Read 12 instead of 120.

Page 103—Reference No. 3—read "Agricultural" instead of Agriculture."

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Published bi-monthly by the Allahabad Agricultural Institute

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Annual Report of the Department of Agricultural Economics And Rural Sociology for the Period July, 1965 to June 30, 1966

MOSES DAS

Staff:

The staff in the Department consisted of Messrs. Moses Das, (Officiating Head), G. D. Pawar and A. C. Broadway. Dr. John H. Foster left in June after completing one year with the Department as a Fulbright Visiting Professor. Mr. A. D. Wycliffe continued to be on study leave abroad. Prof. P. R. H. Acharjee of the Extension Department helped with teaching. This help has been valuable in view of the fact that no appointment was made in place of Mr. A. D. Wycliffe.

Teaching Programme:

The Department had teaching responsibilities for the following classes and subjects in addition to participating in various Short Courses organized by the Departments of Extension and Home Economics. Also, the staff took classes at the Social Education Organizers' Training Centre.

Intermediate Ag. Part II	Elementary Economics
I. D. D. Part II	1. Farm and Dairy Book-keeping 2. Dairy Economics
B.Sc. Agr. Part I	Agricultural Economics and Farm Management
B.Sc. Home Economics Part I	1. Principles of Economics and Rural Economics 2. Rural Sociology
B.Sc. Home Economics Part II	Social Education and Research Methods.
MSc. Ag. Extension (Prev.)	1. Rural Sociology 2. Methods of Social Research
M.Sc. Ag. Extension (Final)	Rural Sociology.

Research:

R. E. 114—"A Study of the Opinion of Progressive Farmers in Chaka Block regarding the Effectiveness of Kisan Melas.

The Department could not take up any Research Projects during the year because of the shortage of staff. Mr. Moses Das, the Officiating Head has been working as the Honorary Director of the Social Education Organizers' Training Centre thus leaving no time for any research. Likewise, other members of the staff have been busy with regular teaching and other responsibilities. However, the Department expects to engage in a couple of research projects next session.

The work on the production of teaching materials and visual aid on Agricultural Economics was continued. Also, Field Trips for studying Farm Management problems were undertaken by the students of B.Sc. Agr. Part I. as part of the requirements for Farm Management Syllabus. These trips have been helpful in collecting factual data for use in classroom discussions.

These field trips also have served as a valuable means of maintaining contacts with the farmers in Chaka Block.

Other Items:

Mr. Moses Das attended the 25th All-India Agricultural Economics Conference in December 1965 held at the University of Allahabad, as a delegate of the Allahabad University. Mr. G. D. Pawar attended the Refresher Course for N.C.C. Officers.

Report of the Agricultural Engineering Department 1965-66

C. V. Paul*

Staff:

P. K. Sur, Irshad Ali, M. K. A. Chisti joined the Department. Four Peace Corps Volunteers R. Thrams, E. Hindin, P. Cunningham, and F. Reed also joined the Tractor Evaluation Programme of the Department. Y. Singh left the Department and also Peace Corps Volunteer E. Hindin left the Tractor Evaluation Programme and transferred to Rajasthan.

Research:

Animal Drawn Potato Digger—The digger consists of a sweep share size 12" to penetrate into the soil to uproot the tubers, behind it a raised grading platform having shaking mechanism through a crank which runs by a 17" diameter wheel fixed with the beam beside the digger bottom. The grading platform 12" long and made of 3/8" mild steel rods spaced at an interval of 1½". The whole grading platform could move vertically up and down 1½"–2". There were two short steel beams fixed at the sides of the digger bottom and made of 3/8" steel flat bar. Further work over the digger is in progress.

Bullock Drawn Reaper—The main objective of this project was to design and develop a Reaper for use in fields to harvest cereal grain crops. However, the objectives have been achieved and the Reaper gave an excellent result.

The design objectives were as follows:

1. Simple, efficient mechanism for cutting the standing crop and collecting the cut crop into regular bundles.
2. Draft requirement suitable for use with medium sized bullocks less than 120 Kg.
3. Working rate to be at least one hectare/day.
4. Small in size to make transportation between fields easy.
5. Simple mechanism so that farmers can operate and adjust the machine.
6. Simplified construction to minimize production cost.

Further additions in design in the Reaper are in progress.

Seed -Cum- Fertilizer Placement Machine—The following objectives should be achieved by the seed-*cum*-fertilizer placement machine.

1. It should sow and fertilize 3 rows at a time.
2. It should be able to be pulled by an ordinary pair of bullocks.
3. It should work as a cultivator, seed drill and as a Fertilizer applier.

Tractor Evaluation Project:

During January through March the number of tractors placed on farms was brought up to six with 2 Rapids, 2 Hinomoto, and 2 Iseki. The farmers were trained on their own farms and given help with harvesting and summer ploughing. After using the tractors a

*Head, Ag. Engineering Department A. A. I.

short time some farmers became interested in pumping water with their tractor for an extra "Zaid" crop and one or two farmers began hauling bricks and other work until the Kharif season of summer, 1966. Also during March through June eight additional farmers were selected and training undertaken so that during the Kharif season of 1967 fourteen farmers would be cooperating in the tractor evaluation project.

The field work with all tractors was satisfactory and the enthusiastic reaction of the cooperating farmers stimulated considerable interest in indigenous developments of a tractor industry. Certain problems were encountered in the area of service and repair and it has been confirmed that operator training is essential, however, no factor was detected which would in itself limit the development of tractors for India.

Contract Research:

During the 1965-66 session four research projects undertaken under contract with Agricultural Development Society were completed. This was the first experience with this type of contract agreement and several modifications in approach were necessary, however, the general outcome has been satisfactory both from the point of view of Allahabad Agricultural Institute and Agricultural Development Society.

Brief comment on the individual projects follow:

1. RE-218—A study of Disk Harrow Design with emphasis on minimum cost of production and operation.

Results: The Disk Harrow Project has been completed according to the plan and objectives in the project outline. The Disk Harrow developed during the course of this Research Project is being manufactured and has been popularly accepted wherever it has been tried in the field. Several novel features have been incorporated in this design such as simple welded frame, large wooden bearings which are oil soaked, and a unique-block design for resisting side thrust.

2. RE-219—A Study of Jute Seeder Design.

Results: During the course of survey of literature and review of current practice an existing proto-type was discovered which required only moderate refinement to satisfy the objectives of the research outline. A very elaborate series of seed metering tests were conducted using a variety of modifications of design and construction materials and a simple low cost production design was developed. Several proto-types of this design were used in field trials and field reports indicated that the production proto-type also satisfied the project requirements.

3. RE—220—A study of Winnowing Fan Design on the basis of durability, economy and safety.

Results: A simple Centrifugal Fan Design with synchronized feeder and with properly sized screens has been developed to the proto-type stage. It is recommended that further experimental work should be conducted with several proto-type machines in various villages. The proto-type appears to satisfy the requirements of the project objectives.

4. TR-221—A Study of Plough Design with emphasis on Mouldboard shape and simplified construction.

Results: An exhaustive literature survey and theoretical analysis of Mouldboard Plough Design and shape factors has been completed under this project. The performance of several ploughs under a variety of field conditions was also carefully observed. After review of the various information collected it was concluded that the project objectives were irrelevant.

In addition K. N. Gaur and S. S. Roychowdhury worked on the following topics under the guidance of C. V. Paul in partial fulfilment of the requirement of their Master's degree in Agricultural Engineering:

(1) Performance Characteristics of Planter Furrow Openers.

(2) Drawbar Performance Characteristics of Beaver Tractor.

Similarly V. K. Agarwal, N. N. Sirothia and R. J. Yadav undertook the work on the following topics unde the guidance of Jaswant Singh in partial fulfilment of the requirement of their Master's Degree in Agricultural Engineering.

(1) Hydraulics of Border Irrigation (Effect of Infiltration Characteristics on Time Area Relationship.)

(2) Correlation of Pan Evaporation Data with Meteorological Variables and variations of Soil Moisture with Time.

(3) Effect of Initial Moisture content of Soil on Infiltration characteristics.

Short Courses:

Two refresher training courses were simultaneously held at the Department from February 24 to March 25, 1966. The first course was offered to Chief Instructors and Training Officers (Agricultural Engineering), on design, development, fabrication, testing, field evaluation, production technology and manufacturing of Improved Agricultural Implements. The second course was organized for Extension and Agriculturlal Officers of Development Blocks and Agricultural Production Schemes on operation, care, repair, maintenance and field demonstrations of Improved Agricultural Implements. The two courses were attended by eighteen and fourteen participants respectively.

The Department also offered a short course of seventeen days duration to eleven Senior Mechanical Assistants of the Agricultural Department, Uttar Pradesh. The course was organized at the request of Additional Director of Agriculture, Uttar Pradesh.

Extension Activities:

The Department provided technical assistance to numerous persons on farm machinery and implements, soil conservation, irrigation and other agricultural engineering fields.

Details of technical conference meetings and lectures delivered:

C. V. Paul, Jaswant Singh, John Balis, R. M. Myles and M. A. C. Aaron attended the Annual Meeting of the Indian Society of Agricultural Engineering at New Delhi from November 11 to 14, 1965. C.V. Paul presided over the first technical session of I. S. A. E. Jaswant Singh was a panel member of the Soil Conservation Section. C. V. Paul, Jaswant Singh and John Balis presented technical papers.

R. K. Varshney attended the Annual Meetıng of the Institution of Engineers (India) Allahabad Sub-Centre at Allahabad on January 2, 1966.

Jaswant Singh delivered lectures at Gram Sewak Training Centre, Faizabad on January 29, 1966 to trainees of Upgraded Scheme and Cooperative Workers.

R. K. Varshney delivered lectures on circuit theory at J. K. Institute of Applied Physics University of Allahabad twice a week throughout the period.

C. V. Paul and R. K. Varshney attended meetings on Agricultural Implements convened by U. P. Government at Lucknow.

Jaswant Singh attended Productivity Seminar at U. P. Agriculture University Pantnagar. He acted as chairman of section on Agricultural Engineering and presented a paper.

Visitors:

Prof. B. Bondurant, Dr. F. Lanham, Head Agricultural Engineering, University of Illinois, Mr. Loyd Johnson, Head, Agricultural Engineering, International Rice Research Institute Philippines, Mr. Lakshmipati, Mr. V. R. Reddy, Managing Director Krishi Engines, Several other members of Package Programme and members of the Advisory Committee of the Development Centre, Dr. R. S. Misra, Dean of Science University of Allahabad. Shri. J. P. Mital, M.I.E., Member, Public Service Commission, U. P.

Other Items:

Forty students were admitted in Four Year B.Sc. Agricultural Engineering Course and five students in M.Sc. Agricultural Engineering Course.

Prof. C. V. Paul, continued to be the Honorary Director of the Agricultural Implement and Power Development Centre, in addition to his responsibilities as Head of the Department of Agricultural Engineering. The staff of the Agricultural Engineering Department gave full cooperation in the activities of Design and Development Projects such as Planters with fertilizer attachment (Single row and two rows bullock drawn and four rows tractor drawn), a rotary power tiller five to seven horse power and a four wheel indigenous tractor of about fifteen horse power, small paddy and wheat threshers. Details may be seen from Progress Reports No. 1 and No. 2 of Design and Development Centre.

Annual Report of the Department of Agronomy
July 1965 to June 1966

P. C. Jaiswal[1] and A. K. Ghosh[2]

Staff:

The staff in the Department consisted of the following members:—

Professor and Head ..	A. K. Ghosh
Associate Professors ..	N. S. R. N. Dey and R. P. Singh
Lecturers ..	P. C. Jaiswal and A. Aziz
Research Assistant ..	P. N. Pande
Fraternal Workers ..	L. G. Ulsaker and K. Makino
Farm Manager ..	M. Siddiqi
Assistant Farm Manager ..	Jagdishwar Sahai.

The departmental activities received a set-back at the sudden and untimely demise of Mr. N. S. R. N. Dey. Mr. Dey served the Agronomy Department for 15 years and rendered valuable service towards its development. He was a very able teacher and was respected both by his students and his colleagues. Mr. .P. N. Pande left the Department at the end of the academic year to continue his graduate study. He assisted in the research programme of the Department for a period of three years. Mr. L. G. Ulsaker and Mr. K. Makino, fraternal workers from America and Japan respectively assisted in the three-fold activities of the Department.

Farm:

The Farm remained under the direct supervision of the Farm Manager who worked under the guidance of Head of the Agronomy Department.

As in the past, the cropping plan was oriented mainly towards the supply of green fodder to the Institute cattle yard. During the year under report, a total of 17,07056 kg. of fodder was raised, the bulk of which was supplied to the Animal Husbandry Department of the Institute. Grain crops were grown mainly during the *Rabi* season and the produce was sold for seed as well as for human consumption. The average yield of major crops grown on the Farm is presented in Table 1.

Research:

During the period under review research projects undertaken by the Department staff are presented in Table 2.

A few short duration trials were conducted by the final year Agronomy students as a part of their practical assignments.

1. Lecturer, Agronomy Department, Agricultural Institute, Allahabad.
2. Professor and Head, Agronomy Department, Agricultural Institute, Allahabad.

TABLE 1—*Area and Yield of Farm Crops*

Crops	Area in Hectares	Production per hectare in Kg.		
		Green Fodder	Grain	Bhusa
Juar	31.83	11458	..	..
Maize	26.54	14895	..	..
Cowpeas	4.46	6085	..	..
Oats	1.90	11460	..	..
Lucerne	2.60	53990	..	..
Berseem	3.00	69598	..	..
Napier	2.15	124335	..	..
Wheat	39.55	..	1088	1830
Gram	12.22	..	168	173
Peas	0.80	..	825	875
Potato	3.40	..	13580 tubers	..

TABLE 2—*Research projects undertaken by Agronomy Department staff*

Project No.	Project leader	Title of the Research Project
R.E. 331 ..	Dr. A. K. Ghosh ..	Evaluation of different herbicides for weed control in rice.
R.E. 332 ..	Mr. N. S. R. N. Dey, Mr. R. P. Singh and Mr. R. N. Srivastava. ..	Development of Hybrid Sorghum.
R.E. 334 ..	Mr. P. N. Pande and Dr. A. K. Ghosh ..	Effectiveness of certain herbicides for weed control in potatoes.
R.E. 335 ..	Mr. L. G. Ulsaker, Mr. John Balis and Mr. Moses Das.	Comparative study of the seedbed preparation practices.
R.E. 336 ..	Mr. R. P. Singh ..	Studies on minimum tillage in Allahabad region.
R.E. 337 ..	Dr. A. K. Ghosh and Mr. P. C. Jaiswal.	Growth and development studies in potatoes.

Summary of Research Projects:

R. E. 331. "*Evaluation of different herbicides for weed control in rice.*"

The experiment was continued in an endeavour to find the most practical method for controlling weeds in paddy. This year DPA (3, 4-dichloropropionanilide), Tok E-25 (2, 4-dichlorophenyl, 4-nitrophenyl ether) and Spontox (a mixture of 2, 4-D and 2, 4, 5-trichlorophenoxy acetic acid) alone and in combination were compared against weeded and unweeded control as a post-emergence herbicide applied three weeks after drilling rice in rows 22.9 cm (9 inches) apart. The net plot measured 1.83 m. × 14.63 m. (6 ft. by 48 ft.) and the experiment was laid out in a randomized complete block design with four replications.

The plots could not be flooded with water to submerge the weeds following application of DPA. Thus weed control due to DPA treatment was not as satisfactory as in the previous year. However, the number of weeds as well as their dry weight in DPA treated plots was significantly lower than weeded and unweeded control. The herbicide was fairly effective in killing both grassy and broadleaf weeds. The crop showed symptoms of injury following the application of herbicides, but the plants recovered afterward. Spontox on the other hand, left the grassy weeds unhurt and did not reduce the weed population significantly. Higher weed population in weeded control observed 10 days after weeding was due to emergence of new weeds. However, the growth of second flux of weeds in weeded control was not much to cause reduction in crop yield. Highest yield of paddy grain was obtained from plots treated with 6.84 Kg DPA/Hectare. However, there was no significant difference in yield between the weeded control and herbicide treated plots. The unweeded control gave significantly lower yield compared to all the weed control treatments except Spontox applied alone at the rate of 0.57 Kg per hectare. The results have been presented in Table 3.

TABLE 3—*Weed intensity, Dry and Fresh Weight of weeds and yield of paddy*

Treatments	Grain yield Kg/ha.	Increase in grain yield over the weeded control %	Weed count	Dry wt. of weeds	Fresh weight of weeds 20 days before harvesting paddy Kg./ha.
			38 days after sowing		
			No. per sq. meter	Gm/sq. meter	
DPA @ 6.84 Kg/hectare ..	3252	134.28	50	7.4	4340
Weeded Control	2574	85.46	454	27.0	2982
DPA @ 3.42 Kg/hectare ..	2509	80.78	71	17.5	7322
DPA @ 3.42 Kg/hectare + Spontox @ 0.57 Kg/hectare ..	2493	79.63	76	12.5	5097
DPA @ 2.28 Kg/hectare + Tok E-25 @ 0.57 Kg/hectare ..	2373	70.99	75	8.7	7215
DPA @ 2.28 Kg/hectare + Spontox @ 0.57 Kg/hectare ..	2228	60.55	55	11.5	6725
DPA @ 1.71 Kg/hectare + Spontox @ 0.57 Kg/hecare ..	2228	60.55	82	9.7	9222
Spontox @ 0.57 Kg/hectare ..	1490	7.41	365	34.3	7972
Unweeded Control	1387	..	593	39.5	12312
C.D. @ P. 05	867	..	245	14.68	3150

R.E. 332. "*Development of Hybrid Sorghum*"

The project was continued for the third year to evaluate the performance of 94 strains of sorghum collected from India and abroad for the purpose of developing hybrid sorghum

for grain and for fodder purposes. Four rows of each strain were sown in July in plots measuring 3.05 m.×2.44 m. (10′×8′). Five earheads of each strain were bagged for the purpose of maintaining the germ plasm. Altogether thirteen observations pertaining to various morphological and agronomical characters of the plants were taken.

The following strains have been selected on the basis of their performance for the purpose of crossing with male sterile Kafir 60.

1. S. X. Sandex	6. Dakota Amber	11. I. S. 1049
2. Texas 610	7. I. S. 2256	12. I. S. 172
3. N. K. 320	8. I. S. 1150	13. Rayer 15
4. Early Felger	9. I. S. 1114	14. Local strain
5. 288 Mroriai	10. I. S. 1018	

R. E. 334. "*Effectiveness of certain herbicides for weed control in potatotes.*"

The project was continued for the third year to further test the effectiveness of EPTC (Ethyl di-n-prophylthiol carbamate), Tok E-25 (2, 4-dichlorophenyl, 4-nitrophenyl ether), and Dacthal (Dimethyl Ester of Tetrachloroterephthalic acid) in controlling weeds in potatoes. This year two rates of the above herbicides and PEBC (Prophyl ethyl-n-butyl-thiolcarbamate) were compared against weeded and unweeded control. Seeds of *Pathri* (*Trianthema menogyna*) were uniformly scattered over the field to ensure sufficient weed stand, as the non-significant differences in the potato yield last year was thought to be primarly because of low weed infestation. The herbicides EPTC and PEBC were applied to the soil prior to planting whereas Tok E-25 and Dacthal were applied immediately after planting of tubers. Herbicides other than Dacthal were incorporated into the soil after their application in the form of spray. Tubers were planted at a spacing of (7.6 cm. inches) in 5.1 to 7.6 cm. (2 to 3 inches) deep furrows spaced 61 cm. (2 feet) apart. Planking was given after covering the tubers with feet. Interculture was done 32 days after planting with a 3-tined cultivator. Weeds were removed in weeded plots by means of *Khurpi* (a hand tool) prior to interculture. Unlike last year earthing was done after interculture. The experiment was laid out in a randomized complete block design and the net plot measured 2.13 m. (7 feet) in width and 9.75 m. (32 feet) in length. Tubers were planted on October 21, 1965 and the crop was harvested on February 1, 1966.

Weed intensity was significantly lower (1/4 to 1/8 of unweeded control) in plots treated with herbicides compared to unweeded control. In general higher rates of herbicides were found to be more effective than the lower rate in controlling weeds but the difference was not significant. *Bathua* (Chenopodium *album*) was the most pre-dominant weed followed by pathri, clover, *motha* (*Cyperus rotundus*) and *Krishna Neel* (*Anagalis arvensis*). Broadleaf weeds were effectively controlled by the herbicides. The herbicides remained fairly effective till 30 to 45 days of their application. Thereafter secondary weed infestation was observed but it did not affect the yield of tubers. Crop injury was noticed only in plots treated with Dacthal at the rate of 15.96 Kg per hectare. Tubers formed were abnormal and the yield was low. Lower weed population in the herbicide treated and weeded control plots resulted in over 100 per cent. increase in dry weight of potato plant and 155.4 per cent. increase in potato (tuber) yield. Unweeded control gave significantly lower yields and the tubers

produced were small in size as compared to weed control treatments. Higher rates of herbicides gave better yield as compared to lower rates but the difference was not significant. The results of the experiment have been summarized in Table 4.

TABLE 4—*Weed intensity, dry weight of potato plant and tuber yield.*

Treatments	Average no. of weeds and their dry wt./ Sq. Meter 30 days after planting		Dry wt. of potato plant 60 days after planting (gm)	Fresh wt. of weeds at harvest Kg/ha.	Yield of potato tubers Kg/ha.
	Weed count	Dry weight (gm)			
Unweeded Control	1,195	81.2	7.7	24132	5247
Weeded Conrtol	1,201	79.2	10.1	9005	13022
Tok E-25 @ 4.56 Kg/hect. ..	189	10.1	19.7	10282	15697
Tok E-25 @ 9.12 Kg/hect. ..	99	5.5	20.3	5480	15697
EPTC @ 4.56 Kg/hect. ..	639	21.1	18.0	9490	11215
EPTC @ 9.12 Kg/hect. ..	195	3.3	17.6	3050	14967
PEBC @ 4.56 Kg/hect. ..	634	25.4	13.9	8360	12780
PEBC @ 9.12 Kg/hect. ..	394	4.7	21.6	4692	14385
Dacthal @ 7.98 Kg/hect. ..	219	2.9	24.4	2750	12440
Dacthal @ 15.96 Kg/hect. ..	147	2.6	17.5	1350	10447
C.D. at P. 05	380	31.2	not significant.	5772	5006

R.E. 335. "*Comparative study of seedbed preparation practices*":

The project was undertaken in July 1965 to compare the relative costs and benefits of seedbed preparation for maize and wheat at several levels of tillage intensity using various combinations of conventional and improved tillage implements.

The experiment on maize was laid out on a deep well-drained sandy loam soil in a randomized complete block design with eight treatments and three replications. The treatments consisted of three intensities of seedbed preparation using shovel harrow—an improved implement similar in performance to deshi plough, three intensities of seedbed preparation using combination of mouldboard plough and disc harrow; a seedbed of simply one ploughing and another of one rototilling. Each plot measured 12.20 m. (40 feet) in length and 6.10 m. (20 feet) in width.

A local variety of flint corn known as "Jaunpur Yellow" was sown with a bullock drawn seed-*cum*-fertilizer drill developed by the Implement Development Centre of the Agricultural Institute. Rows were 61 cm (2 feet) apart with about 12.7 to 15.2 cm. (5 to 6 inches) spacing within the row. The manurial schedule consisted of basal dressings of 56.3 kg nitrogen and 54.0 kg each of phosphorus and potash to an hectare applied in the form

of ammonium sulphate, superphosphate and potassium sulphate respectively. One month later ammonium sulphate was applied as a side dressing to supply 56.3 kg nitrogen per hectare. One irrigation had to be given two weeks after planting owing to scanty rainfall. Interculture was done once using a wheel hoe. The yield estimates were made from 40 sq. m. samples (five 40 feet rows and one 17 feet row, equivalent to 1/100th acre) within each plot.

Lodging occurred after five weeks of planting to the extent of 26 to 35 per cent. primarily due to potash deficiency as the deficiency symptoms appeared in the leaves and earheads and there was no evidence to indicate pathogenic infection. The stalks making an angle of 45° or less with the ground were considered to have lodged. The differences were non-significant. The data on grain and stover yield also showed non-significant differences. However, there was a significant difference in the cost of eight seedbed treatments.

The maize crop was followed by wheat in the rabi season keeping the same design, layout and the tillage treatments. Wheat seeds (Var. C.13) treated with agrosan G. N. and Gammaxene was sown on November 9, 1965 with a bullock-drawn seed drill (Gunti). In addition to a basal dose of 14.4 kg nitrogen, 28.8 kg phosphorus and 72 kg potash, urea was top dressed 6 weeks after sowing to supply 45 kg nitrogen per hectare. In order to control weeds Atrazine was sprayed three days before top dressing at the rate of 0.5 kg per hectare. In all three irrigations were given to the crop. Lodging occurred in all the plots to the extent of 40 per cent. The statistical analysis did not show any significant difference in the yield of grain. However, the straw yield was found to be highly significant for unaccountable reasons. The results have been presented in Table 5 and 6.

TABLE 5—*Economics of Tillage Treatments for seedbed preparation* (*on maize crop*)

Tillage Treatments	Production Qt./hec.		Value of produce Rs./hec.	Cost of seedbed preparation using 10 HP Tractor Rs./hec.	Cost of production Rs./hec.	Net return Rs./hec.
	Grain	Stover				
1. Field cultivator ran 4 times ..	45.0	220	3421	28	1307	2114
2. Field cultivator ran 8 times ..	48.0	212	3537	56	1341	2196
3. Field cultivator ran 12 times ..	48.8	228	3659	84	1371	2288
4. Ploughing once and Disc harrowing twice	48.5	218	3592	47	1333	2259
5. Ploughing once and Disc harrowing thrice	46.1	217	3461	53	1341	2120
6. Ploughing twice and Disc harrowing thrice	43.7	192	3213	85	1372	1841
7. Roto-tillage once	54.6	227	3951	33	1320	2631
8. Ploughing once	54.6	255	4086	33	1319	2767

TABLE 6—*Yield of wheat grain and straw in kg per hectare*

Treatments	Wheat Grain	Wheat Straw	Straw to Grain Ratio
1. Field cultivator ran 4 times	1397	5820	4.2:1
2. Field cultivator ran 8 times	1397	5533	4.0:1
3. Field cultivator ran 12 times	1602	4868	3.0:1
4. Ploughing once and Disc harrowing twice	1454	7245	5.0:1
5. Ploughing once and Disc harrowing thrice	1314	6051	4.6:1
6. Ploughing twice and Disc harrowing thrice	1274	5084	4.0:1
7. Roto-Tilling once	1643	6479	4.0:1
8. Ploughing once	1415	7097	5.0:1
C. D. at P.01	Not significant.		

R.E. 336 "*Studies on minimum tillage in Allahabad Region*":

The project was undertaken to study the effects of minimum tillage on the yield of wheat and berra—a mixture of barley and gram. The experiment was laid out in two sets of simple randomized block design with three different methods of seedbed preparation. The crops were sown on the 9th and 10th of November, 1965 in rows 22.9 cm (9 inches) apart. Wheat was sown with a seed rate of 75 kg per hectare and berra was sown with a seed rate of 62.5 kg per hectare. The proportion of barley and gram in the mixture was in the ratio of 1.5 : 1 by weight. The wheat and berra crop was fertilized at the rate of 62.5 and 31.3 kg nitrogen per hectare respectively. Both the crops were irrigated four times. There was no significant difference in either the yield of grain or straw in any of the crop. The results are presented in Table 7 and 8.

TABLE 7—*Yield of wheat in kg per hectare*

Tillage Treatments	Yield	
	Grain	Straw
1. Ploughings with disc plough 4 times each followed by planking ..	1415	4943
2. Ploughing with mouldboard plough once and disc harrowing thrice, each followed by planking	1710	5318
3. Ploughing with mouldboard plough once followed by planking ..	1570	4883

TABLE 8—*Yield of Berra in kg per hectare*

Tillage Treatments	Yield	
	Grain	Straw
1. Ploughings with desi plough thrice followed by one planking ..	1968	3865
2. Ploughing with mouldboard plough once and disc harrowing once each followed by planking	2068	4308
3. Ploughing with mouldboard plough once followed by planking ..	1933	4985

R. E. 337. *"Growth and Development Studies in Potatoes":*

The project was undertaken in November 1965 to study leaf growth in relation to tuber initiation, rate and duration of bulking in potatoes as influenced by agronomic management practices and its subsequent effect on the yield. Each of the undermentioned variables were tested this year using O. N. 1645 variety of potato.

A. Moisture levels
   1. Irrigation at an interval of 20 days
   2. Irrigation at an interval of 10 days

B. Method of planting
   1. Planting of sprouted tubers on flat seedbed in shallow furrows followed by earthing.
   2. Planting of sprouted tubers on ridges by dibbling.

C. Levels of Nitrogen
   1. 50 kg nitrogen per hectare.
   2. 100 kg nitrogen per hectare.
   3. 200 kg nitrogen per hectare.

The experiment was laid out in a split-plot design with irrigation levels in the main-plot and combination of method of planting and nitrogen level treatments in the sub-plots. The treatments were replicated three times. Each sub-plot measured 11.58×6.10 m (38′×20′). The entire dose of nitrogen was applied in the form of Urea prior to planting of tubers. Superphosphate and potassium sulphate were applied as a basal dosage to supply 100 kg of phosphorus and 150 kg of potash respectively to an hectare. Tubers were planted on November 15 and 16, 1965 with a spacing of 15.2 cm (6 inches) in rows spaced 61 cm (two feet) apart. Interculture was done 32 days after planting. Earthing was given after interculture using a bullock-drawn cultivator having a furrow attachment. The crop was harvested in the middle of March, 1966.

Plants and tubers from 30.5cm (one foot) row were dug at weekly intervals commencing from the third week for taking observations on leaf area, fresh and dry weight of top growth, and rate of bulking. In the absence of a planemeter leaf area was determined by sorting out the leaflets into seven size groups and then multiplying the leaflet falling in each group by its corresponding area, determined from the squares enclosed by the representative leaflet

on graph paper. The rate of increase in weight of potato tuber was taken as an index for the rate of bulking. Leaving nine rows for determining the crop yield, ten rows in each plot were marked out for taking the weekly observations. It was not possible to study the moisture depletion pattern for want of reliable moisture meter. Starch content of the tubers was determined from their average specific gravity. The experiment has to be repeated for drawing valid conclusions. However, the general trends observed are as follows:—

Yield in potatoes seem to be influenced by the leaf area of the plant, higher yields being obtained from plots where the leaf area was more. Early crop emergence, higher fertility levels and frequent irrigation (10 days interval) are conducive to production of greater leaf area and consequently for higher yield of potato tubers. There is increase in both the number and the weight of tubers. Shallow planting is undersirable especialy when soil moisture content is low at the time of planting as the upper soil tends to dry out soon resulting in diminished leaf area owing to delay in crop emergence. Less frequent irrigation and lower fertility levels is most likely to result in early bulking of tubers. This may be desirable for early harvest but not for higher tuber yield. Fresh or dry weight of top growth can fairly well serve as an index to leaf area as the latter have been found to be more or less directly proportional to the former. The results have been summarized in Table 9.

TABLE 9—*Average leaf area index, weight of top growth and tubers from one foot row and yield of potato.*

Treatments	Leaf area Index	Top Growth (gm)		Tubers (gm)	Yield Kg/ hectare
		Fresh	Dry		
A. *Moisture levels*					
1. Irrigation at 20 days interval ..	1.79	299.9	25.8	488.4	23413
2. Irrigation at 10 days interval. ..	2.14	390.0	31.6	604.3	28448
B. *Method of Planting*					
1. Planting in furrows followed by earthing	2.03	358.3	29.2	590.1	27983
2. Dibbling on ridges	1.92	335.3	28.3	502.7	23880
C. *Nitrogen levels*					
1. 50 kg. nitrogen/hec.	1.49	236.4	24.4	472.0	20858
2. 100 kg. nitrogen/hec.	1.97	332.7	28.0	539.6	26515
3. 200 kg. nitrogen/hec.	2.42	465.8	36.8	627.6	30440

METEOROLOGICAL REPORT FOR THE YEAR 1965-66

Daily readings of temperature, relative humidity, rainfall, atmospheric pressure, and wind velocity (by Beaufort Scale) was taken regularly. The records of meteorological observations from June 1 1965 to May 31, 1966 are summarized in Table 10.

As compared to last year, the kharif season was quite dry owing to 40 per cent. reduction in the rainfall. The monsoon rain from July to September, 1965 was 336.04 mm. as against 556.01 mm recorded during the corresponding period in 1964. The total rainfall from June 1, 1965 to May 31, 1966 was 384.81 mm as against 1258.57 mm and 641.86 mm recorded during corresponding period of 1963-64 and 1964-65 respectively. The amount of rain received in October was not enough to dispense with preparatoryirrigation for sowing of rabi crops.

TABLE 10—*Monthly Mean Meteorological Readings of maximum and minimum temperatures, relative humidity, atmospheric pressure and wind velocity.*

Month	Temperature °F			Relative Humidity at 8 a.m.	Rainfall MM	Atmospheric Pressure	Wind Velocity
	Mean	Max.	Min.			Inches of mercury	Miles/hr.
1965							
June	97.0	105.5	88.4	44.3	6.86	28.20	6.1
July	89.8	96.6	82.9	76.4	117.86	28.91	6.6
August ..	87.6	94.2	81.1	76.6	99.82	28.92	5.6
Sept.	84.2	91.2	77.1	80.0	118.36	29.08	4.8
Oct.	81.5	92.6	70.4	77.8	25.65	29.20	2.8
Nov.	72.2	85.9	58.5	71.2	..	29.33	2.2
Dec.	61.5	75.7	47.3	75.8	8.64	29.37	1.8
1966							
Jan.	61.4	75.6	47.1	77.9	..	29.40	3.5
Feb.	71.5	88.3	54.7	66.8	6.86	29.30	2.9
March ..	75.2	93.1	57.3	45.2	0.76	29.23	2.8
April ..	87.0	101.3	72.7	31.4	..	29.16	3.8
May	95.8	109.0	82.6	38.0	..	28.08	6.4

Extension Activities:

As in the past, the staff of the Agronomy Department took part in the extension activities of the Institute.

Technical Conferences, Meetings and Seminars:

Mr. P. C. Jaiswal attended the Summer Institute in Agronomy for College Teachers held at the B.A. College of Agriculture, Anand (Gujarat) from June 8 to July 15, 1966. The Summer Institute was organized in collaboration with the University Grants Commission, New Delhi and the United States Agency for International Development.

Publications:

Jaiswal, P. C. and A. K. Ghosh. Annual Report of the Department of Agronomy. "*The Allahabad Farmer*," Vol 39(5), September, 1965.

Singh, R. P. Para Grass. "*The Allahabad Farmer*", Vol. 40(3), May, 1966.

Singh, R. P. and A. Aziz. Lentil (Masur). "*The Allahabad Farmer*", Vol. 40(4), July, Vide Letter Dated 12th. Jan. 1967.

Annual Report of the Department of Animal Husbandry for the Year 1965-1966

O. P. Agarwala*

Staff:

Mr. O. P. Agarwala continued to be the Head of the Department during the period covered under the report. He was assisted in the Department administrative work by Messrs. J. N. Mathur, R. Sagar, G. P. Agarwala, J. Reddy, J. Gilmore, V. K. Goel and J. P. Pandey who joined as A. H. Manager on 16-7-65.

Mr. V. K. Goel joined on 10-9-65 as Lecturer for Intermediate classes and left on 31-3-66.

Mr. J. Gilmore assisted by Mr. R. Sagar continued to work in Pilot Broiler Project.

Teaching and Short Courses

The Department continued to teach general animal husbandry and veterinary science to Intermediate Agriculture, Management of Dairy Cattle in Health and Disease to I.D.D. (DH), Farm. Animals and Their Products to B.Sc. Ag. I, Livestock Nutrition, Breeding and Hygiene to B.Sc. Ag., Part II and livestock Management and Housing to B.Sc. Ag. Eng. Part I.

Following courses were held during the period covered under the report.

Name of Short Course	*Date commenced*	*Date ended*	*Trainees*
1. Poultry Raising ..	19-4-65	24-4-65	Inst. Students and Outsiders
2. General A. H. ..	10-1-66	15-1-66	Instructresses of Gram Sevikas.
3. Do. ..	27-1-66	19-2-66	Milk Supervisors of U. P. Govt. Dept. of Co-operatives.

Technical Conferences

Following technical conferences were attended by Dept. Staff on dates as indicated:

Sl. No.	Name of Staff	Name of Conference	Place	Dates
1	O. P. Agarwala	Board of A. H. and Fisheries, Govt. of U. P.	Lucknow	5-5-65 to 6-6-65.
2	Ditto	Board of Dairy Education, Meeting.	Bombay	2-6-65 to 6-6-65.
3	Ditto	Board of A. H. and Fisheries, Govt. of U. P.	Lucknow	14-10-65 to 15-10-65.
4	Ditto	Board of Dairy Education	Harringhata	28-10-65 to 29-10-65.
5	Ditto	Ditto	Bombay	14-1-66 tc 16-1-66.
6	Ditto	3rd Dairy Industry Conference	Do.	17-1-66 to 21-1-66.
7	J. A. Gilmore	Committee on Relief and Gift Supply.	Delhi	14-3-66 to 19-3-66.

*Professor and Head, Department of Animal Husbandry, Allahabad Agricultural Institute, Allahabad.

Research

Research work constituted an important activity of the department during the year under report. The long-term projects were continued and several short term projects were completed, while a few of them are still in progress. A brief report on the work done and findings from each of the projects are included in this report.

A. DAIRY CATTLE

(*i*) *Crossbreeding Zebu and Foreign Cattle* (*RE 414*):

The following phases of the Cattle breeding project were continued:

(*a*) Selection of individuals within Red Sindhi herd on the basis of individual performance, pedigree and the progeny.

(*b*) Crossbreeding Jersey and Brown Swiss bulls with Red Sindhi cows and cows with 7/8th or more Red Sindhi inheritance.

(*c*) Breeding Jersey crossbred cows to establish a herd of individuals having between 3/8th to 5/8th Jersey inheritance (to be called *Jersind*).

(*d*) Breeding half-bred Brown Swiss cows to establish a herd of individuals having 3/8th to 5/8ths Brown Swiss inheritance (to be called *Brown Sind*).

The milk production records for the lactations completed druing the year by cows of different breeds or grades are given in Table I.

TABLE I.—*Milk Production for All Lactations Completed during* 1965-1966.

S. no.	Breed	Lact. Comp.	Average Lact. Production (in Kgs)	Average Days in Milk	Average 305 Days Production (in Kgs)	Average Dry Days Preceding Lact.	Milking Average (in Kgs)	Overall Average (in Kgs)
1	Red Sindhi ..	28	1501.44	303	1482.12	78	4.96	3.42
2	1/8 J×7/8 R. Sindhi ..	12	1397.70	291	1397.70	65	4.80	3.93
3	1/4 J×3/4 R. Sindhi ..	10	1965.50	294	1965.50	47	6.69	5.76
4	1/2 J×1/2 R. Sindhi ..	24	2003.36	349	1873.36	79	5.74	4.67
5	1/2 BS×R. Sindhi ..	6	2386.47	368	2078.77	65	6.48	5.50
6	Jersey×R. Sindhi Crosses	120	1862.46	355	1737.59	73	5.24	4.39
7	Miscellaneous ..	36	1898.18	397	1600.00	65	4.78	4.17
8	Murrah	11	1954.30	275	1954.30	105	7.10	5.14
9	Jersind	76	1510.57	354	1348.42	72	4.26	3.73
Weighted Avg. for the Herd		323	1793.26	363	1619.10	63	4.93	4.20
Weighted Avg. for last Year		77	1978.46	354	1774.13	41	5.59	5.01

Milk production averages were lower this year than last year. 1/2 BS×RS produced more milk than 1/2 Jersey × R.S. "Jersind" production averages were far below expectation this year.

Table II presents the age and weight at first calving of heifers of different breeds or grades during the period covered by the report.

TABLE II.—*Average Age and Weight at First Calving during* 1965-1966.

Serial number	Breed or Group	No. of Animals	Avg. Age at First Calving (Yrs)	Avg. Weight at First Calving(Kgs)
1	*Jersind* (This year)	12	2.89	275.50
2	,, (last year)	11	2.85	267.76
	Weighted Avg. for the Herd (This year)	12	2.89	275.50
	Ditto (Last year)	36	2.82	280.91

In *Jersind* group with higher age at first calving this year heavier weights at first parturition were obtained.

B. POULTRY

1. *To Compare the Differences in Growth Rate of Feed Effiiciency of Chicks up to* 6 *weeks of Age by Replacing undecorticated Ground Nut Cake with Deoiled Ground Nut Cake in Chick Starter Ration.* (*RE 478*) *by O. P. Agarwala and G. P. Agarwala.*

One hundred and twenty day old W. L. chicks were used for this study. It was found that deoiled ground nut cake not only can replace ground nut cake to a great extent (20%) in chick starter ration but probably due to its higher protein and lower fibre content, it even gives significantly higher growth rate.

2. *To Study Effect of Inclusion of Different Levels of Carotenoids in Poultry Layer Ration for Egg Yolk Colouration* (*RE 482*) *by I. N. Mathur:*

Eighty laying hens of White Leghorn breed were divided into 4 groups of 20 birds each. While Group I (Control) received no carotenoid in its feed, Carotenoid @ 10 gms. and 20 gms. per 1000 Kgs. of feed was supplied to Groups II, III and IV respectively. Eggs from Group IV showed the most desirable and acceptable colouration of the yolk

3. *To Observe the Difference in Growth Rate and Feed Efficiency of Broiler Chicks by Replacing Fish Meals with Vegetable Protein Source and Balancing the Methionine Requirement with Synthetic Methionine in Broiler and Finisher Rations* (*RE 482*) *by G. P. Agarwala and J. A Gilmore.*

In this experiment involving 120 day-old broiler chicks (Vauntress × Arbor Acre 50) it was found that growth rate decreased when the fish meal was decreased and replaced by vegetable protein sources plus supplemented methionine. It was interesting to note that gain in weight per Kg. of feed was greater in the group of birds having methionine added

4. *To Study Effect of 'Anti-biotics' in layer Ration on Egg Production (AHR 15) by V. K. Goel G. P. Agarwala and O. P. Agarwala.*

This study was undertaken with 15 W. L. pullets ready to lay eggs from 15-2-65 to 31-3-66. The result showed no significant increase in Egg Production.

C. RESEARCH PUBLICATIONS

The following papers were published by the Department during the period covered under the report.

1. Agarwala, O. P. and Yadav, S. S. (1965). Studies on the effects of simple and complex (commercial brands) mineral supplements on Sheep. *Ind. Vet. Jour.*, **42**, 7.
2. Agarwala, G. P. and Agarwala, O. P. (1965). To study the effect of different coccidiostats on growth rate of chicks. *Poultry Guide* July, 1965.
3. Agarwala, G. P. and Agarwala, O. P. (1965). Replacing Maize in Chick Starter Ration. *Poultry Guide*, Ag., 1965.
4. Agarwala, O. P. and Agarwala, G. P. (1965). To compare the differences in growth rate of baby chicks up to 6 weeks of age by using different commercial mashes for chicks with that of Allahabad Agricultural Institute Chick Starter Ration. *Poultry Guide*, Sept. 1965.
5. Agarwala, O. P. and Agarwala, G. P. (1965). To compare the growth rate in chicks by using Rice *Kana* as a substitute for wheat bran in chick starter ration. *Indian Poultry Gazette*, **49**, 3.
6. Agarwala, O. P. and Agarwala, G. P. (1965). To compare the growth rate in chicks by using cane molasses as a substitute for maize in chick starter ration. *Ind. Poultry Gazette*, **49**, 3.
7. Lall, S. P. and Agarwala, O. P. (1965). To compare the differences in growth rate of chicks up to 6 weeks of age by using different minerals in chick starter ration. *Poultry Guide*, Nov., 1965.
8. Sagar, R., Lall, S. P. and Agarwala, O. P. (1965). To study the effect of feeding different antibiotics on growth of broiler chicks. *Poultry Guide* Dec. 1965.
9. Lall, S. P. and Agarwala, O. P. (1966). To compare the differences in growth rate of chicks up to six weeks of age by using different vitamins in chick starter ration. *Poultry Guide*, Jan. 1966.
10. Agarwala, O. P. and Agarwala, G. P. (1966). To compare the growth rate in chicks by using Jowar as a substitute for Maize in chick starter ration. *Poultry Guide*, March, 1966.
11. Agarwala, O. P. and Reddy, J. (1966). To compare the difference in rate of growth of chicks up to six weeks of age by replacing wheat bran with that of deoiled rice polish in chick starter ration. *Indian Poultry Gazette*, **50**, 4.
12. Agarwala, O. P. and Agarwala, G. P. (1966). Pfizer's Egg Formulae, Its effect on Egg Production. *Ind. Poultry Gazette*, **50**, 4.

EXTENSION

A. DAIRY CATTLE

1. *A. I. SCHEME FOR THE IMPROVEMENT OF VILLAGE CATTLE.*

The work of the scheme continued as last year. Number of inseminations done and results of inseminations are given in Table III.

TABLE III—*Record of Insemination and Pregnancy Examination*

Zone	No. of Inseminations	Repeated		Not able to Test	Number Pregnant
		In Institute	In Villages		
A	32	4	2	12	14
B	51	12	12	14	23
C	31	9	5	11	6
Total ..	124	25	19	37	43
Last year's Total	90	6	18	28	38

In order to stop indiscriminate breeding by non-descript bulls, castration was done as and when requests were made. A record of castration done during the period covered by the report is given in Table IV.

TABLE IV—*Record of Castration*

Zone	Number of Castration	Total for last year
A	12	10
B	22	31
C	0	0
Total	34	41

Average monthly milk yields during 1965-66 in rural and urban areas is given in Table V.

TABLE V—*Average Monthly Milk Production of Cow (in lbs.)*

Stage of Lactation (months)	Number of Lactations Completed											
	1st		2nd		3rd		4th		5th		6th	
	R	U	R	U	R	U	R	U	R	U	R	U
1-2	173	420	170	374	150	600	150	316	105	420	300	420
2-5	105	180	276	300	231	360	150	170	75	450	300	120
5-over ..	198	304	100	420	160	436	120	366	70	420	150	150

R = Rural, U = Urban.

A total of 108 female calves have been born so far during the entire period of the Scheme, 1958-59. Out of these 20 heifers are now pregnant and expected to calve in next year.

* Financed by Church of Brethren

Out of 26 heifers born out of improved bulls during the entire period of the Scheme eight are in second lactation and three in third lactation. Their comparative production records with dams are given in Table VI.

TABLE VI—*Dam, Daughter Production in lbs. of Heifers Born in Scheme*

S.No.	Dams Production Days/ Milk Prod.	Sire No. and Breed	Daughter's Production No. of Days/Milk 1st Lact.	2nd Lact.	3rd Lact.	Differences in favour of Daughter (per day production) in lbs.
1	300/4800	886 B. S. ..	360/4750 ..	330/3500 ..	60/570 ..	3.05
2	210/840	361 Jersind ..	270/1900 ..	210/1890 ..	180/660 ..	12.00
3	330/4680	72 B.S. ..	630/10460 ..	450/7600 ..	80/1800 ..	4.00
4	330/1880	1019 Jersey ..	270/3820 ..	60/663 ..	..	4.50
5	270/2200	1765 Jersey ..	270/4080 ..	300/3900 ..	..	10.50
6	330/2380	1765 Jersey ..	330/4140 ..	210/2460 ..	..	5.50
7	330/3400	361 Jersind ..	240/3300 ..	270/3540 ..	..	2.50
8	335/4200	1019 Jersey ..	390/6420 ..	360/7030 ..	..	6.00
9	270/4320	1765 Jersey ..	540/8600 ..	..	..	2.00
10	330/1760	71 B.S. ..	270/3580 ..	..	..	8.50
11	270/4320	71 B.S. ..	270/4440 ..	..	..	1.50
12	300/2300	1765 Jersey ..	360/5760 ..	..	..	3.50
13	360/4680	71 B.S. ..	330/4960 ..	..	..	1.00
14	510/4860	71 B.S. ..	360/3700 ..	..	..	3.00
15	270/3180	886 B. S ..	240/4620 ..	..	..	7.50
16	270/3180	71 B.S. ..	390/4800 ..	..	..	1.00
17	300/4400	1765 Jersey ..	330/7920 ..	..	..	8.00
18	300/6000	71 B.S. ..	360/8684 ..	..	..	4.00
19	240/3360	1765 Jersey ..	360/7200 ..	..	..	6.00
20	300/3000	1765 Jersey ..	330/7940 ..	..	..	8.00
21	180/1380	71 B.S. ..	450/9260 ..	..	..	12.00
22	300/3000	Do. ..	480/9060 ..	..	..	9.00
23	180/1380	Do. ..	480/7580 ..	..	..	10.00
24	300/3000	1765 Jersey ..	180/2520 ..	..	..	4.00
25	420/4960	71 B.S. ..	360/5020 ..	..	..	2.50
26	Died just after calving.	71 B.S. ..	330/2630 ..	..	..	..

B.S.=Brown Swiss

In all 265 animals were treated for diseases and injuries. In order to check spread of infectious diseases vaccinations against H. S. and B.Q. were carried out in the villages. Total number of vaccinations done against different diseases during the year are given in Table VII.

TABLE VII—*Vaccination Record*

Zone	H.S.	B.Q.	Anthrax	Total
A	197	198	..	395
B	262	340	..	602
C	147	98	..	245
Total ..	606	636	..	1242
Last year's Total	316	269	290	875

2. *SCHEME* FOR IMPROVEMENT OF ZEBUS BY CROSSBREEDING WITH JERSEY AND BROWN SWISS BULLS:*

Survey of the area was again conducted by 13-3-66.

A total of 110 villages now have been finally selected. These villages have been grouped under eight sub-centres. Each sub-centre has been placed under a stockman.

Details of tour programme of each stockman continues to be the same as reported in previous year.

Training of all stockmen for A. I. Technique and pregnancy examination continued this year also as and when they visited H. Q. No fresh stockman was appointed unless he underwent at least 3 months' training at his own cost at the Head Quarter and in the villages. Record of monthly milk production of each cow under the Scheme was recorded as last year. Average monthly milk classified according to lactation, number and stage of lactation within a lactation is given in table VIII.

TABLE VIII—*Average Monthly Milk Production in lbs. during* 1965-66

Stage of Lactation (Months)	Number of Lactation Completed							
	1st	2nd	3rd	4th	5th	6th	7th	Over
1-2	890	160	110	165	88	305	60	30
2-5	1,680	150	100	130	45	20	105	102
5-over	250	285	155	170	92	81	90	39

*Financed by Freedom from Hunger Campaign Committee, U. K.

A general improvement in milk production has been observed this year due to improvement in general management conditions.

In order to check indiscriminate breeding by unwanted bulls, mass castration of male calves and bulls was carried out. A total of 344 castrations as compared to 172 last year were done during the period covered under the report. Details of these castrations sub-centre-wise are given in Table IX.

TABLE IX—*Report of Castrations Performed*

Name of Sub-Centre	Number of Castrations Done
Sarangpur	43
Ghoorpur	30
Gauhaniya	65
Jari	106
Mahuariya	62
Rampur	12
Pandewara	24
Bheerpur	2
Total ..	344
Last Year's Total	172

In order to protect animals against contagious and infectious diseases, vaccinations were carried out in each sub-centre. Details are given in Table X sub-centre-wise and disease-wise of these vaccinations.

TABLE X.—*Record of Vaccinations.*

Name of Sub-Centre	H.S.	B.Q.	Anthrax	Total
Sarangapur	1,014	661	112	1787
Ghoorpur	585	472	84	1121
Gauhaniya	545	450	126	1121
Jari	546	430	116	1092
Mahuariya	609	436	62	1107
Rampur	427	392	..	819
Pandewara	279	533	..	612
Bheerpur	663	569	120	1352
.. Total ..	4648	3943	620	9211
Last Year's Total	4351	1823	832	7006

Each stockman was provided with a first aid box so as to treat animals of his sub-centre. A total of treatments of various ailments given and their distribution sub-centre-wise is given in Table XI.

TABLE XI—*Records of Treatments Given in Villages.*

Name of Sub-Centre	*No. of Treatments*
Sarangapur	45
Ghoorpur	42
Gauhaniya	48
Jari	90
Mahuariya	101
Rampur	55
Pandewara	40
Bheerpur	43
Total	464
Last year's Total	503

NOTE.—This drop in number of treatments is due to larger animal covered under vaccination programme this year and probably due to better management practices so adopted.

In order to popularise aims of the Scheme and advantages of artificial insemination, a Cattle Fair in each sub-centre was organized.

A survey was made in each sub-centre to ascertain number of cows not coming in heat and conceived due to various reproduction disorders. Some of these cows were treated and cured. Record of this survey and results achieved are given in table XII.

TABLE XII—*Survey of Treatment Records of Cows with Reproduction Troubles.*

Name of sub-centre	No. of Cows Recorded	No. Tested	No. Cured
Sarangapur	42	22	14
Ghoorpur	21	12	8
Gauhaniya	19	10	5
Jari	33	28	13
Mauhariya	32	21	16
Rampur	19	11	5
Pandewara	11	6	3
Bheerpur	10	8	5
Total	187	118	69
Last year's Total	444	149	66

In order to review progress and exchange views, a meeting of all stockmen at H. Q. once a month was continued to be called. Similar meeting once a month at each zone was also held. In total all stockmen met twice a month and stockmen of each zone met three times a month.

Semen was made available at sub-centre of each stockman three times a week (Tuesdays, Thursdays and Saturdays).

Results of inseminations are given in Table XIII.

TABLE XIII—*Resuls of Inseminations*

Name of sub-centre	No. of Insemina-tions	Repeated as able to Record		Not able to Test	No. Pregnant
		By stockman	In Villages		
Sarangapur	59	14	9	14	12
Ghoorpur	51	15	8	10	9
Gauhaniya	56	4	7	12	10
Jari	32	3	9	0	10
Mahuariya	40	6	4	11	11
Rampur	12	2	4	4	9
Pandewara	24	3	9	6	3
Bheerpur	29	5	8	7	8
.. Total	303	52	58	73	72
Last year's Total	1,238	23	52	140	27

Calves born out of inseminations carried out under Scheme were tatooed just after birth for purpose of identification. Their health was monthly checked. A record of number of calves born during the period under report is given in Table XIV.

TABLE XIV—*Pregnancy Record.*

Name of sub-Centre	No. of Pregnancy Born	Sex	
		Male	Female
Sarangapur	12	3	9
Ghoorpur	6	6	..
Gauhaniya	6	3	3
Jari	4	1	6
Mahuariya	8	5	3
Rampur	8	4	4
Pandewara	2	2	..
Bheerpur	6	2	4
Total	52	26	26

B. PIGS

1. Pig for Progress Scheme*

Zonal programme of visits by stockmen continued to be the same as reported last year. Except in a few villages under the Scheme where more attention was paid to the grazing of pigs, there was not much change in the way of keeping or feeding the pigs. As before they were kept on kuchcha floor and did not get any concentrate mixture. The villages did not take advantage of reduced rate. Grazing remained as the chief source of food for the pigs.

There was no report of any case of swine fever during the period under review. The age at first farrowing remained the same as last year, viz. 12 months.

More live pigs were sold by the villagers this year as compared to last year. The number of pigs slaughtered however, showed a decrease in number. The ratio of pork sold to pork consumed remained the same. On an average the villagers got 50 NP more per Kg. of pork this year than last year. This is shown in Table XV.

TABLE XV.—*Slaughter and Disposal Summary of Pigs in Entire Block*

Zone	No. Sold	No. Slaughtered	Age at Sale and Slaughter	Meat Consumed	Sold	Rate of Sale
A	18	6	1 month to 2 yrs.	10%	90%	Rs. 2 per Kilo.
B	109	72	Ditto ..	Ditto	Ditto	..
Total A and B ..	127	78		10%	90%	Rs. 2 per Kilo.
Last Year's Total A and B.	90	98	..	10%	90%	Re. 1.50 per Kilo.

Table XVI gives the number of pigs of different sex supplied from the Institute to the villages under the scheme. More pigs were supplied this year as compared to last year.

TABLE XVI—*No. of Boars and Piglings Supplied to Villagers under the Scheme*

Zone	Piglings and Female	Boars	Grand Total
A—Kanti	..	1	1
Sandi	1	..	1
B—Nayakapurwa	2	3	5
Chakdondi	..	2	2
Chheonki	2	1	3
Bastor	1	1	2
.. Total	6	8	14
Last year's Total	5	7	12

*Financed by Bread for the World Organization of United Church of Germany.

It is gratifying to note that 195 male and 150 female cross-bred piglings were born in the villages under the Scheme by the boars supplied from the Institute. The corresponding figures in the previous year were only 36 and 38 respectively.

The villagers sold more cross-bred progeny this year as compared to last year. (Table XVII).

TABLE XVII—*No. of cross-bred Progeny Born and Their Disposal by the Villagers.*

Name of Village	No. of Piglings Born			No. Sold	No. Died	No. Slaughtered
	Female	Male	Total			
A—Dandi	24	33	57	38	1	4
Mahewa	16	16	32	26	4	2
B—Maherapur	12	20	32	17	11	1
Chaka	15	23	38	18	8	3
Nayakapurwa	50	50	100	76	6	2
Cheoki	12	23	35	15	4	1
Mahuaria	12	15	27	14	5	..
Chakdondi	9	15	24	7	5	..
.. Total	150	195	345	211	44	12
Last Year's Total	38	36	74	34	6	6

Table XVIII shows the number of pigs vaccinated against Swine Fever in each of the villages under the Scheme. More animals were vaccinated during the period under review.

TABLE XVIII—*Swine Fever Vaccination Record*

Name of Village	No. Vaccinated	Date
A Dandi	17	27-5-65
Mahewa	23	1-6-65
B Nayakapurwa	6	21-6-65
Do.	17	11-8-65
Do.	17	20-12-65
Do.	18	29-12-65
Chaka	12	11-8-65
Do.	6	18-8-65
Do.	7	3-1-66
Do.	11	4-1-66
Mahrapur	18	10-6-65
Do.	12	12-8-65
.. Total	164	
Last Year's Total	104	

Table XIX shows that the pigs in the villages under the scheme did not suffer from any major disease. They were treated for minor things only.

TABLE XIX—*Village Treatment Report*

Name of Village	Pig No.	Disease	Date
Zone A—			
Dandi	72 Male	Wounded ..	14-10-65
Do	,,	Do ..	1-11-65
Do	,,	Do ..	23-11-65
Zone B—			
Mahrapur	76 Male ..	Wounded ..	15-10-65
Do	Do ..	Germs in Head	30-10-65
Do	Do ..	Wounded ..	24-11-65
Bajaha	154 Male ..	Fever ..	12-8-65

The number of Cross-bred progeny now present in the villages under the Scheme showed a remarkable increase this year. Whereas out of 34 cross-bred pigs were present last year, the number is 175 now as shown in Table XX.

TABLE XX—*Present Strength of Cross-bred Pigs in Villages under the Scheme.*

Zone	Male	Female	Total
A	21	13	34
B	90	51	141
Total ..	111	64	175
Last Year's Total	..	..	34

ORGANIZED ACTIVITIES

A. GOATS AND SHEEP

The Institute Goats and Sheep programme continued as reported last year. The average birth and 3 months weight of kid and lambs born during the year are given in Table XXI.

TABLE XXI—*Average Birth and 3 Months Weight of Kids and Lambs*

Serial number	Breed	Sex	Average Weight at Birth Weight (Kgs)	Average Weight at 3 Months Weight (Kgs)
1	Goat Barbari (B) ..	Male ..	1.2	3.0
		Female ..	1.5	3.8
2	Goat Jamuna Pari ..	Male ..	nil.	nil.
		Female ..	nil	nil.
3	Goat J×B	Male ..	1.6	4.0
		Female ..	2.2	7.3
4	Sheep, Bikaneri ..	Male ..	2.8	16.8
		Female ..	2.8	14.4

Eight sheep were slaughtered this year and results of their dressing performance are given in Table XXII.

TABLE XXII—*Results From Slaughter of Sheep for the Year.*

Serial No.	Sheep No.	Sex	Weight at Slaughter	Weight of Carcass	% of Dressing	Return/Kg	
						Carcass Wt. (Rs.)	Live Wt. (Rs.)
1	72	Male ..	18.500	11.600	61	2.35	1.46
2	39	,, ..	32.000	14.200	50.	2.30	1.16
3	73	,, ..	25.200	13.000	50.	2.15	1.13
4	79	,, ..	15.000	9.500	53.	2.36	1.20
5	76	,, ..	17.800	11.400	53	2.00	1.26
6	4	Female	20.000	8.500	45	2.09	1.12
7	26	,, ..	20.500	12.900	51.9	2.20	1.10
8	86	,, ..	..	4.300	13.0	1.91	1.74
	Average				47.1	2.17	1.27
	,, for last year				56.4	2.40	1.09

B.—PIGS.

The Institute pig programme continued as in previous year. Thirteen pigs were slaughtered this year and results of their dressing performance are given in Table XXIII.

TABLE XXIII—*Results from Slaughter of Pigs*

Serial No.	Pig No.	Sex	Wt. at Slaughter (Kgs)	Wt. of Carcass (Kgs)	% Dressing (Shipper's Style)	Return per Kg. of	
						Carcass (Rs.)	Live Wt. (Rs.)
1	58	F ..	113.000	91.350	80.8	2.99	2.41
2	141	F ..	63.000	48.300	69.5	2.96	2.08
3	104	M ..	119.000	100.100	78.7	2.90	2.28
4	55	M ..	126.000	103.300	77.7	2.93	2.23
5	175	M ..	27.000	20.700			
6	176	M ..	19.000	20.000	78.33	3.31	2.59
7	208	M ..	23.000	16.600			
8	103	F ..	99.000	84.500	82.4	3.41	2.81
9	255	M ..	24.000	17.400	72.00	3.25	2.37
10	251	M ..	27.500	21.100			
11	107	F ..	62.000	50.600	78.14	3.29	2.57
12	594	F ..	127.000	106.100	80.94	3.40	2.75
13	83	F ..	119.100	94.000	96.5	3.98	2.58
	Wgithed Summary			%59.56	%79.50	%3.24	%2.47
	,,	,, of last year		64.00	71.00	2.89	2.07

NOTE: M—Male, F—Female

Average birth and weaning weights of piglings born during the year are given in Table XXIV.

TABLE XXIV—*Average Birth and Weaning Weights of Piglings.*

Serial number	Sex	Average weight at	
		Birth (lbs)	Weaning (lbs)
1	.. .. Male	1.9	19.0
2	.. .. Female	1.9	22.4

C. POULTRY

The Institute Poultry programme continued as in previous year. The average monthly production of eggs and age at first egg laid are given in Table XXV.

TABLE XXV—*Summary of Average Monthly Egg Production and Age at First Egg Laid.*

Serial number	Breed	Average Monthly Egg Prod.	Average Age at First Egg Laid (Months-days)
1	White Leghorn	8.2	6—9
2	Brown Leghorn	7.4	8—20
3	Australorp	8.7	Nil.
4	Rhode Island Red	9.9	8—18
5	New Hampshire..	8.4	10—00
6	Black Minorca	9.5	8—14
7	Black Leghorn	9.3	8—5
8	Duck	3.7	Nil.

The Summary of Hatching Records is given in Table XXVI.

TABLE XXVI—*Summary of Hatching Record*

Serial number	Breed	No. of Eggs Set	Infertile %	Dead Embryos %	Hatchability	
					% of all eggs	% of Fertile eggs
1	White Leghorn	1794	12.4	3.8	71.18	87.5
2	Australorp	44	40.9	11.3	29.5	59.0
3	Black Minorca	155	11.6	3.8	65.8	88.4
4	Rhode Island Red	205	15.6	2.9	67.3	84.4
5	Brown Leghorn	447	10.3	3.8	71.1	89.7
6	New Hampshire	90	26.6	8.8	46.6	73.3
7	Black Leghorn	106	4.6	5.6	75.4	95.2
	Weighted Average .. .. Total	2841	12.9	4.0	69.7	80.0

D—PILOT BROILER PROJECT

This project as mentioned in last year's report is financed by United Church of Canada for a total period of 3 years including services of Mr. J. A. Gilmore. This project as Pilot Project, terminates on 31-3-1967.

(i) *Construction*—One more 35 tonne capacity aluminium bin was installed this year, bringing to total storage capacity of 50 tons of feed.

(ii) *Breeder*—585 breeders were brought forward from 1964-65. In all 1259 breeders were purchased this year, out of which 630 were purchased in September, 1965 and 629 were purchased in Jan. 1966.

(iii) *Egg Production and Hatching*—32,547 eggs were produced during the year covered under this report. Out of these 29,455 were set for hatching and rest were sold as table eggs. Per cent. of hatchability for all eggs set was 65.

(iv) *Broiler Chicks*—19,237 chicks were hatched from home incubator. 7938 chicks were purchased from outside. On an average 3 Kg. of feed was consumed by these birds to produce 1 Kg. of live weight. On an average live weight of each bird at slaughter was 1.4 Kg.

(v) *Processing*—19177 chicks and 47 breeders male were dressed during this year.

Feeding Programme with slight changes continued to be the same as last year.

Annual Report of the Department of Biology for 1965-66

J. C. Edward*

General:

J. C. Edward continued to be the Officiating Head of the Department with B. A. David (Entomology), R. N. Srivastava (Genetics and Plant Breeding), Zafar Naim (Bacteriology and Plant Pathology), R. B. Singh (Botany), S. L. Misra (Zoology) and G. R. Singh (Research Assistant, left the Institute in March, 1966 for a better position in Mussoorie). Miss S. A. Hamlin from Anglican Church of Canada, joined in October 1965 (30-10-65). During summer 1966 Zafar Naim lead a contingent of N.C.C. Cadets and other ranks who were attached with the regular army 3/3 Gorkha Rifles at A. P. O. 99, and R. B. Singh participated in Summer Institute in Biology at St. Johns College Agra. J. C. Edward and S. L. Misra attended the 2nd Post Graduate Course of three months' duration in Nematology conducted by the International Agricultural Centre, The Netherland. J. B. Chitamber looked after the Department during summer 1966 when J. C. Edward was abroad to attend the Post Graduate Course in Nematology.

Teaching:

As usual the Department continued to teach B.Sc. (Ag.), B.Sc. (Home Science Extension), Intermediate (Ag.), Intermediate (Home Science) and I. D. D. classes.

The custom of meeting daily over a cup of tea in the forenoon to discuss informally problems and management of the Department and to promote mutual understanding continued throughout the course of the year. Apart from this, monthly Departmental meetings were held to discuss academic matters. The Department continued to accommodate the office of the Coordinator of Research.

The Annual Farmers' Fair during January-February 1966, usually held at the Institute in October was substituted by a stall in Kumbh Mela by the Extension Department and it was fully supported by the Department. The department continued to assist the Farmers in controlling the pests by way of supply insecticides and suggesting recommendations for the control of specific pests. Specimens of diseased or damaged plants by pests received from Farmers and orchardists in and outside Allahabad were identified and control measures suggested.

Research:

RE-516—*Field trials with some insecticides for the control of Mango Leaf Cutting Weevil, Deporaus emarginatus* (Curculionidae: Coleoptera).

This project was started in July 1965 and completed in May 1965. Field trials were made with emulsions of various insecticides namely—Endrin, Malathion, Metacid-Combi, Lindane, Metasystex and D.D.T to control the mango leaf-cutting weevil, *Deporaus emarginatus* (Curculionidae: Coleoptera) at recommended doses. 0.24% D.D.T spray proved

*Officiating Head, Biology Department, Allahabad Agricultural Institute.

to be more effective and had better persistence. The beetle appears to cut the lamina 8-10 days after application of the spray, at places where the film of the spray ruptures due to expansion of the growing lamina. In view of this repetition of spray at 10 days' interval has been recommended

RE-517—*Survey of endoparasitic nematodes of field and fruit crops of A. A. I.*

In the following table is furnished a list of host plants with the endoparasitic nematodes identified up to genus.

HOST	*ENDOPARASITES RECORDED*	
1. *Field Crops:*		
(*a*) Maize	*Paratylenchus,*	*Ditylenchus*
(*b*) Pea	*Paratylenchus,*	*Meloidogyne*
(*c*) Cowpea	*Heterodera*	
(*d*) Arhar	*Pratylenchus,*	*Heterodera.*

No endoparasites were encountered in the following field crops of the campus during the year 1965-66.

(i) Rice, (ii) Mung, (iii) Urd, (iv) Bajra, (v) Wheat, (vi) Barley and (vii) Sugarcane.

2. *Vegetable crops:*		
(*a*) Tomato	*Meloidogyne*	
(*b*) Potato	*Pratylenchus,*	*Meloidogyne*
(*c*) Bhindi	*Meloidogyne*	
(*d*) Brinjal	Do.	
3. *Fruit trees:*		
(*a*) Fig	*Meloidogyne* sp.	
(*b*) Grapevine	Do.	
(*c*) Banana	Do.	
(*d*) Aonla	Do.	
(*e*) Citruses	*Pratylenchus,*	*Tylenchulus*

Further work on specific identity will be published separately.

RE-518—*Survey of plant parasitic nematodes with special reference to those associated with Rhizosphere of forest trees and crops in their vicinity of the surrounding districts of Allahabad.*

This project was commenced on November 18th, 1966. Thus far only Rihand area has been surveyed. The report will be presented elsewhere on completion of the project.

Studies on Citrus canker and potential parasitic fungi associated with roots of commercial Citrus varieties in decline in the orchards of A.A.I.

Five isolations of *Xanthomonas citri* have been made from five Citrus varieties. Interinoculation tests by various methods are being conducted with these isolates aside from studying their cultural and biochemical characters with a view to finding out whether races within the species prevail. *Fusarium* sp. and *Macrophomina phaseoli* were found to be the two potential pathogens associated with roots of Citruses in decline. Pathogenicity trials with the fungi

are under way using some of the common root stocks *viz*. Karna, Hill lemon, Sweet lime, Musambi, Gajanima.

RESEARCH PUBLICATIONS

1. Edward J. C., Sohan Lal Misra and G.R. Singh—*Hemicriconemoides birchfieldi* n. sp (Nematoda: Criconematidae) from Allahabad, Uttar Pradesh. 1964 *Nematologica* **11**:157—161.

2. Edward J. C., Sohan Lal Misra and G. R. Singh—Qualitative and Quantitative Studies of Plant Parasitic Nematodes Associated with Rhizospheres of some Citrus Plants. 1965. *Punjab Horticultural Journal* Vol. V. (1).

3. Edward J.C. and Sohan Lal Misra. *Criconema Vishwanathum* n. sp. and four other hitherto described Criconematinae. 1965. *Nematologica* **11**: 266—272.

4. Edward J. C., Sohan Lal Misra and G. R. Singh—Some observations on Citrus nematodes (*Tylenchulus semipenetrans* Cobb.) associated with the roots of Gajanimma (*Citruspenniviesiculata* Tanaka). 1966. *The Allahabad Farmer* **93** (4): 1—5.

5. Edward J. C. and Gauri Shanker—Root stock trial for guava (*Psidium guajava* L), *The Allahabad Farmer* **38**: (6) 1964.

6. Gauri Shanker, R. N. Srivastava, R. B. Singh and J. C. Edward—Occurrence of tetraploidy in Guava (*Psidium guajava* L.) *The Allahabad Farmer* **38**: 6.

7. Singh R. B.—Effect of nitrogen and phosphorus on ash and carbon content of Moong, (*Phaseclus radiatus*). *The Allahabad Farmer*: **38**(6). 1964.

IN PRESS

(*a*) Edward J. C. and Sohan Lal Misra—*Paratylenchus micoletzkus* n. sp with the description of allotype of *P. nainianus*.

(*b*) Edward J. C. and Sohan Lal Misra—Two new species of the Genus Criconemoides.

Annual Report of the Chemistry Department for Year 1965-66

C. O. Das[1] and S. Malik[2]

Staff:

During the year under report viz. 1st July, 1965 to 30th June, 1966 the Chemistry Department staff comprised of Dr. C. O. Das, Professor and Head of the Department, Messrs. S. Malik, K. K. Srivastava, P. D. Rawate, Associate Professors, D. P. Sharma, M. L. Varshney, Lecturers, G. C. Gupta, R. P. Srivastava, K. K. Bhargava and Rajendra P. Srivastava, Research Assistants.

Dr. Das continued to teach theoretical Agricultural Chemistry with special emphasis on soils to the B.Sc. (Ag.) Final Year class. In addition to the above he had complete charge of the theoretical and practical Biochemistry courses of the B.Sc. Part I Home Economics class. Dr. Das was also incharge of the engineering chemistry course for the B.Sc. Eng. I and II Years. Messrs. Malik, Srivastava and Rawate were jointly responsible for the theoretical and practical classes of the B.Sc. (Agri.) Final Year students. Mr. Srivastava was also incharge of the I.D.D. (D.H.) II Year theoretical and practical chemistry classes and Mr. Rawate was incharge of the I.D.D. (D.H.) I Year theoretical and practical chemistry classes. Mr. Malik was incharge of the practical chemistry class for the B.Sc. I Year Eng. students.

Messrs. Sharma and Varshney were incharge of the theoretical and practical chemistry classes of the Intermediate Agricultural chemistry course. Mr. Sharma was also responsible for the theory and practical chemistry classes of the I Year Home Science students. Mr. Varshney was responsible for the theory and practical chemistry classes of the II Year Home Science students.

The chemistry results of the B.Sc. (Agri.) (Final), B.Sc. Home Economics Part I, B.Sc. Eng. I Year, Inter. Ag. Part II, I.D.D. (D.H.) Part I and Part II were satisfactorily encouraging due to the constant efforts of the chemistry staff.

Research:

The chemistry department completed the co-ordinated I.C.A.R. research scheme on "Standardization of methods of estimating total solids and solids-not-fat in milk by calculations" and Dr. Das was the officer in charge of the scheme. The research scheme terminated as of 31st March, 1966 and Mr. R. P. Srivastava is in the process of compiling the conclusive data. Messrs. K. K. Bhargava and Rajendra P. Srivastava joined post-graduate agricultural courses during the 1965-66 session.

Mr. G. C. Gupta, Research Assistant has constantly analysed various feed samples for crude proteins, crude fiber, fat content, calcium content sent by Mr. Gilmore of the Animal

[1] Head, Chemistry Department Agriculture Institute Allahabad.
[2] Associate Professor Agriculture Institute Allahabad.

Husbandry Department. Mr. Gupta also analysed many soil samples sent by the National Extension Service Block at Chaka, Allahabad as a scheme ("Extension of Soil Testing," service to cultivators) of the Government of Uttar Pradesh, for recommending fertilizer treatments of the soils. These analyses included available nitrogen, available potassium availabe phosphorus, total carbon and pH. Several soil samples were analysed for their porosity and humus content.

Extension Activities:

We extended full co-operation with qualified research personnel and up-to-date equipments for village demonstrations, whenever called upon to do so by the Extension Department.

Participation in Technical Conferences:

Mr. P. D. Rawate represented the Chemistry Department at the 1966 Summer Institute in Chemistry for College Teachers held at the Chemistry Department of the Aligarh University, during June, 1966.

Dr. C. O. Das attended annual session of the Indian Science Congress, which was held at Chandigarh in the month of January, 1966. He was also elected a member of the Executive Committee of Soil Science.

Annual Report of Department of Dairy Technology 1965-66

T. VISHWAS RAO*

Staff:

James N. Warner, M.Sc., Professor, left for furlough in U.S.A., in August 1965. T. Vishwas Rao, M.Sc. (Ag.), M.Sc. Food Science (Techn.), Associate Professor, joined duty in September, (on return from U.S.A·) after completing post-graduate studies at Michigan State University. Oliver Brave, M.Sc. (Ag.), Associate Professor, R. P. Arora, B.A., I.D.D., Dairy Manager, and A. Q. Khan, B.Sc. (Ag.), Research Assistant and later appointed as Lecturer in Dairy Technology, continued in their posts. T. R. Srivastava, I.D.D., joined as Dairy Supervisor in November, 1965, but resigned in February (to take up a job with Polsons, Patna). Raja Ram Katiyar, B.Sc. (Ag.), joined as Assistant Dairy Supervisor (milk procurement) in January and resigned in May to pursue higher studies.

Dairy Operations:

A comparative statement of dairy products handled during the years 1965-66 and 1964-65 are given in tables I and II.

TABLE I—*Receipts of Milk and Cream, and Butter Production*

	Milk		Cream		Butter Manufactured	
	Institute Herd	Villages	Home	Contractors	Home	Contractors
1965-66	134 924 kg.	163 452 kg.	3659 kg.	27890 kg.	1825 kg.	16891 kg.
1964-65	167 464 kg.	160 789 kg.	3654 kg.	23306 kg.	1219 kg.	15407 kg.
Difference	32 540 kg. (less)	2 663 kg. (more)	5 kg. (more)	4584 kg. (more)	606 kg. (more)	1490 kg. (more)

The Institute cattle yard supplied 32,540 kg. less milk (18.8%) as compared to last year, as seen in table I. It is reported that less and poorer quality fodder available from the farm in 1965-66 was the major cause of lower yields. There was a slight increase, 2663 kg. milk (1.54%), received from the village milk producers. Efforts to increase milk collection from the village milk producers, at Ghurpur milk collecting centre, did not yield much

*Officiating Head, Department of Dairy Technology, Agricultural Institute, Allahabad.

dividend due to extreme drought conditions during the year. Considerable increase in receipts of cream from cream contractors, that is 4,584 kg. (19.2%), enabled an increase in butter production of 1490 kg. (9.7%), as compared to last year.

TABLE II—*Sale of Milk and Milk Products*

	Milk Kg.	Butter Kg.	Dahi Kg.	Ghee Kg.	Cheese Kg.	Ice cream Kg.	Skim milk Kg.	Cream Kg.	Flavoured milk (bottles)	Average daily fluid milk sale Kg.
1965-66	281,584	19,387	3406	553	1126	3915	1801	1853	497	771
1964-65	295,478	16,120	4217	358	1327	4271	3595	597	2115	807
Difference	13,894 (less)	3,267 (more)	811 (less)	195 (more)	201 (less)	356 (less)	1794 (less)	1256 (more)	1618 (less)	36 (less)

Table II shows that the dairy handled 13,894 kg. milk (4.7%) less this year. The daily average sale was 771 kg. as against 807 kg. last year. There was a considerable increase in the sale of butter, 3267 kg. (20.2%), Ghee 1950 kg. (54.4%), and cream, 1256 kg. (210%), as compared to last year.

Products that registered less sale are dahi, 811 kg. (19.2%), cheese, 201 kg. (15.1%), ice cream, 356 kg. (8.5%), and skim milk, 1794 kg. (49.8%).

Installation of dairy equipment donated by UNICEF for our dairy training programme began in November, 1965. M/s. Vulcan-Laval (Pvt.) Ltd., Bombay, undertock this job. It is expected that the new plant will be in operation during the latter part of this fiscal year.

As reported in earlier annual reports of this department, UNICEF provided a number of equipment items for our dairy operations. That equipment is capable of handling 5,000 to 6,000 litres of pasteurised milk, and about 120 kg. of butter a day; besides a seasonal handling of 5,000 kg. cheddar cheese, 2,000 kg. ice cream, 5,000 kg. ghee, and 2,000 kg. dahi per year. The equipment consists of modern high temperature and short time pasteuriser, plate cooler, insulated storage tanks, cream separator-standardizer, and a homogenizer for homogenizing ice cream mixture. Sufficient equipment for steam, hot water, and refrigeration were also provided. Through a donation from the U. P. Government, several items of equipment from indigenous sources were purchased. These include a ghee kettle (boiler), a stainless steel cheese vat, a rotary can washer, and a delivery van.

Research:

The research project on titratable acidity of freshly drawn milk continued. Valuable data were collected. Work on this project continues.

Other Activities:

Mr. T. V. Rao attended the Third Dairy Industry Conference of Indian Dairy Science Association held in Bombay in January, 1966, and presented a research paper based on M.Sc. Food Science (Tech.) thesis submitted to Michigan State University, U.S.A. Later in March he attended a conference of "Action for Food Production" (Afpro) as a Technical Adviser.

In U.S.A. Mr. Warner visited several dairies in Hawaii and Washington states, and three different state universities. He attended two inter-state meetings sponsored by the Spokane, Washington, Chamber of Commerce, one on live-stock production and one on agriculture, and participated in the 33rd Institute of Dairying of Washington State University.

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Annual Report of the Extension Department 1965-66

P. R. H. ACHARJEE[1]

The Department of Extension is continuing to serve the useful purpose of having the major responsibility in assisting the other Departments of the Allahabad Agricultural Institute to make and maintain contact with the villages. It is also engaged in developing its own programmes. Other Departments such as the Animal Husbandry, Biology and Home Economics Departments have operated cattle breeding, poultry raising, plant protection and applied nutrition projects.

The Co-ordination Committee set up by the Extension Department for development work in the villages, with the representatives of the various Departments of the Institute, the Mukhya Sevika Training Centre and the Block Development Officer of the Chaka Block has proved to be helpful in coordinating Extension field work. This committee met once a month.

Despite shortage of staff, the Extension Department staff strived to arrange and carry on its regular schedule of work, in addition to other duties. Mr. K. S. Ghosh, appointed temporarily in the post of the Mr. T. P. Singh (on leave abroad for higher studies), left in 1966. Mrs. D. Newton, the Lady Field Assistant had suddenly died in 1966. Mrs. Newton was a very devoted worker and had years of useful service life left. Her sudden demise was keenly felt by her colleagues and many other friends.

The major Extension activities during the year under report are given below:

A.—Extension work in collaboration with the National Extension Service Blocks:

I.—Organization of Vikas Mela and Sammelan:

(1) Special arrangements were made in organizing an Agricultural Exhibition on the Kumbh Mela grounds at Allahabad. Large numbers of people coming from the different parts of India and Nepal, visited the stall set up by the Extension Department. This Exhibition was held in place of the Farmers' Fair held annually at the Institute.

Apart from this, three Vikas Sammelans were held for the benefit of the rural people during the year. A Mahila Mela held in the month of February 1966, was attended by 400 rural women.

II—Short Training Courses of Villagers:

The following training courses for the benefit of the village people were organized during the year under report:

Apart from the above, special Kharif campaigns were held in the villages of Champatpur, Badalganj, Imalia, Bagbana, Chaukatha and Bhandra, which were attended by about

[1]. Associate Prof., Extension Department, Allahabad Agricultural Institute, Allahabad.

700 farmers. In addition, 15 short courses were organized for the benefit of farmers in relation to the following:—

Serial number	Village	No. of participant	Duration	Topic
1	Purwakhas	5	1 day	Seed multiplication
2	Hathigan	10	1 day	Ditto
3	Tangha-Ka-Purwa	15	1 day	Ditto
4	Keshopur	5	1 day	Ditto
5	Rampur	10	1 day	Kitchen gardening and summer vegetable growing.
6	Lawain	10	1 day	Ditto ditto
7	Bajetha	15	1 day	Ditto ditto
8	Tilkowar	10	1 day	Ditto ditto
9	Rajapur	5	1 day	Seed selection, seed treatment, and plant protection.
10	Semra Kalbana	10	1 day	Ditto ditto
11	Bongi	5	1 day	Ditto ditto
12	Manakpore	5	1 day	Ditto ditto

(1) Improved Kitchen-Gardening.
(2) Poultry Keeping.
(3) Cattle Feeding.
(4) Use of Improved Implements.

III—Educational Tour for Villagers:—

A total of 130 progressive farmers' trips in three batches were organized for the visit to the Agricultural Institute farm and the Magh Mela. Apart from this the progressive farmers were taken out to Jaunpur, Mirzapur, Banaras, Agra and Kanpur on tour for observation of farms of progressive farmers of the localities. One tour of selected farmers of Chaka Development Block was also organized for visiting other development blocks.

IV—Youth Work:—

During the period under report, three youth rallies were held and ten youth study tours were organized. Eight short courses were arranged also for the benefit of the youths on the following:

(1) Improved Kitchen Gardening.
(2) Hygiene and First Aid.
(3) Use of Fertilizers.
(4) Control Measures for Pests and Diseases.

(5) Use of Implements.
(6) Plantation of Orchards.
(7) Vegetable Growing.
(8) Multiplication of Improved Seed.

A total of 40 kitchen gardens were established and the planting of a new vegetable perennial '*Parwal*' was introduced. Thirty meetings-*cum*-lectures for the benefit of the youth were organized.

About 60 youths of the villages Bagbana, Champatpur and Chaukatha have taken to Kitchen Gardening for growing of improved varieties of vegetables.

V—Work among Village women:—

As before, a regular programme of Inservice Training for Gram Sevikas and Gram Laxmis and other professional women was continued during the year under report. Development work in relation to home and family was carreid out in collaboration with Gram Laxmis, Gram Sevikas, Social Education Training Centre and other Institute staff in relation to better food and nutrition, inoculation against cholera, sewing, knitting and embroidery.

Apart from this two sammelans were organized. Demonstrations were given on preparation of food articles. A special drama was staged by children and about 40 women from the villages of Champatpur, Bagbana and Sarangapur in the Chaka Block had attended.

A cultural programme was organized for the benefit of school children belonging to Bagbana, Champatpur, Chaukatha and Sarangapur villages of the Chaka Block. Two *Balbaris* were organized for the benefit of children.

A batch of 33 village women was taken to the Industrial Training Centre and to Varanasi for observation in relation to cottage industry, particularly for making of small carpets out of waste materials.

VI—Demonstrations:—

A large number of demonstrations were performed during the year under report on improved manurial practices, line sowing, budding and grafting, orchard planting, layout of kitchen gardening, use and fitting of improved implements, hybrid maize and hybrid jowar.

In the three villages of Bagbana, Chaukatha and Champatpur, 30 farmers adopted the practice of dibbling in wheat in 27 acres.

VII—Seminar:

A seminar for the members of the youth club was held at Karchana, during the year under report.

VIII—Inservice Training of N. E. S. staff:—

As reported in the past, this programme in relation to the various improved practices were continued once in a month, in the four Development Blocks of Chaka, Kaurihar, Jasra and Karchhana of the Allahabad District.

IX—Training Courses in Extension Method:—

(*a*) The Department of Extension is in-charge for teaching the subject of Extension to the students of B.Sc. (Home Economics), I.D.D. (Dairy Husbandry) and B.Sc. (Ag. Engineering) students, which is included in their syllabi. It is expected that the Department, will be required soon to teach this subject of B.Sc. (Ag.) students, for whom it is going to be compulsory, soon the University approves and announces about it.

(*b*) A short course was offered for the benefit of the trainees from the Leonard Theological College, Jabalpur, between 29th October and 13th November, 1965.

X—P.oduction of Extension Teaching Materials:—

The Extension Department produced Flannelgraph, Flashcards, Posters, Charts, Leaflets, Cover Pages, etc. for teaching purposes, Extension field work and for meetings and conferences, etc.

The publication of the monthly Hindi village newspaper *Hamar Gaon* was continued for providing useful information to the rural people.

XI—Tour of Extension Staff:—

Mrs. D. Newton, Lady Field Assistant was sent on tour to Raipur, M. P. for attending a meeting and later on for attending a training course in Extension, held in the month of November, 1965, at the Extension Education Institute, Nilokheri, Punjab.

XII—Mukhya Sevika Training Centre:—

This centre continued to operate under the sponsorship of the Ministry of Community Development, Food and Agriculture, Government of India. The 19th batch of trainees completed their course of training during the year under report.

Annual Report of Social Education Organizers' Training Centre, from August, 1965 to July, 1966

MOSES DAS*

Training Programme:

The Job Training Course for the XIX Batch of Mukhya Sevikas was organized from 16th September, 1965 to 30th July, 1966. 48 trainees-5 from Bihar, 7 from Punjab and 36 from U. P., joined this course. One trainee from U. P. left the course in the middle and another trainee died at her home. Forty-six trainees continued up to the end of the course. Our training programme covered the following:

(1) *Theory:* Theoritical knowledge was imparted on various subjects like Rural Sociology, Community Development, Panchayati Raj, Social Education, Home Science, Women and Child Welfare, etc. The syllabus prescribed by the Ministry of Community Development was followed with minor changes. Teaching was done through lecture-*cum*-discussion method with the help of various teaching aids.

This year we had a number of guest lecturers from the Allahabad Agricultural Institute and from the Planning Department.

(2) *Concurrent Field Work:* The trainees were sent out regularly to our 4 adopted villages—Mauhari, Sandwakalan, Dadri and Dabhaon of Chaka Block twice a week for 3½ hours a day. The trainees took up various projects and activities in the villages for the welfare of women and children under the guidance of their respective Field Supervisors and this provided them a very useful experience. In their weekly group discussions and monthly seminars on field work the trainees got an opportunity to exchange their ideas and experiences on the various aspects of our field work programme.

(*a*) *Practical work at the Centre:* The trainees were given practical training in various arts and crafts which are useful in the rural areas. Practicals were also arranged in sewing, cooking, home decoration, kitchen-gardening, etc. This year the trainees could also get an opportunity to do practicals in the Home Economics Department. The trainees also regularly did manual work in the Hostel as well as in the Centre's premises.

(*b*) *Camps, tours, etc:* During the period under review the following visits, tours and camps were organized:—

(i) Visit to some educational institutional and other important places of Allahabad.

(ii) Educational trip to Lucknow (Literacy House, S.E.O.T.C. and other Institutions) for three days. Educational trip to Chitrakut for three days.

(iii) Study tour to some selected Blocks of U.P. and Rajasthan. It also included visit to S.E.O.T.C, Orientation and Study Centre and other important educational institutions of Udaipur.

Honorary Director, S. E. O. T. C. Agricultural Institute Allahabad.

(iv) Block Placement Camp for two weeks was organised in 9 Blocks—7 in U. P., 1 in Punjab and 1 in Bihar. In this connection it would not be out of place to mention that according to the instructions of the Ministry the trainees are required to be sent in their respective States for placement.

(c) *Short courses:* The following short courses were organized:—

(i) Adult Literacy Course for one week by the Literacy House, Lucknow.

(ii) Animal Husbandry Course for one week by the Animal Husbandry Department of the Allahabad Agricultural Institute.

(iii) First Aid and Home Nursing Course for two months through Red Cross Association, Allahabad.

(iv) Food Preservation Course for three weeks by the Food Preservation and Canning Centre of U. P. Government.

(v) Guides Captains Course of 10 days' duration by the Guides Commissioner of U. P.

Trainees' Panchayat:—

The trainees Panchayat organized various co-curricular activities such as games and sports, recreational and cutural activities, picnics, etc.

Every Saturday one period was devoted for morning assembly in which the trainees and the members of the staff delivered talks on religion and culture. Outside speakers, like Rev. J. W. Adams, Chaplain of the Institute, Rev. Mangalwadi of Bible Society, Swamiji of Ram Krishna Mission occasionally delivered talks on religion.

The Panchayat also maintained Kitchen Gardening Plots, Poultry and the Cooperative Store.

Staff Changes:—

(a) The following left the Centre to take up positions elsewhere:

(1) Miss Deepali Ghoshal joined as Art Instructor on 22nd November, 1965 in place of Shri V. K. Gupta and she resigned and left on 14th May, 1966.

(2) Miss R. Bhatia, Senior Instructor resigned and left on 5th May, 1966.

(3) Mr. V. G. Brierton, Movie Operator resigned and left on 29th May, 1966.

(4) Mr. C. Cutting, Library Clerk left on 1st April, 1966 due to the abolition of the post by the Ministry.

(b) The Art Assistant's Post has been abolished and Mr. V. A. Khan who was working as Art Assistant has been appointed as Art Instructor from 1st July, 1966.

(c) Mrs. L. S. S. Dey has been promoted to the post of Senior Instructress.

Seminars and Training Course:—

Mrs. B. G. Pawar, Senior Instructress was sent to the National Institute of Community Development, Hyderabad for 4½ months Instructors course on June 2nd, 1966.

Annual Report of the Home Economics Department for the Year, 1965-66

P. Ventura*

Staff:

Miss Ventura continues to be the officiating Head of the Home Economics Department and Mrs. Verghese and Miss Sukhnandan as Associate Professors. Mrs. Dwyer as Lecturer and Miss Kanthamani as Research Assistant. Due to economic drive, the posts of the Research Assistants were abolished, and so her services were also terminated from July, 1966.

Mrs. Rawate is the Nursery School Teacher. About 25—30 children attend the Nursery.

Enrolment:

July session started with:

year Home Science	18
II year Home Science	5
III year H.Ec.	12
IV year H.Ec.	11

Out of five students in II Year 3 passed, one got supplementary.

In IV year all the students passed and four got Ist division, rest got secondd ivision.

Most of them joined various colleges—2 at Home Science College, Jabalpur doing B. Ed., one doing Extension at I.A.R.I., New Delhi, two doing M.Sc. in Extension at Lady Irwin College, New Delhi.

Farmer's Fair:

The Farmer's Fair was held in the Kumbh Mela which was going on then.

Short Course:

A Refresher Course in "Agricultural Practices, including the study of Simple Farm implements (Major), Clothing construction for farm families and Utilization of Available Foods (Minor)" was conducted from September 15 to October 30, 1965 under the auspices of the Directorate of Extension, Ministry of Food and Agriculture. Fourteen Instructresses from various Gram Sevika Training Centres and Mukhya Sevikas attended this course. The Chief Guest during the Valedictory function was Sri J. D. Shukla, Commissioner of Allahabad.

The B.Sc. students visited the village twice a week for their field practical work.

* P. Ventura offg. Head, Home Economics Department Ag. Int. Allahabad.

Annual Report of Horticulture Department for the Year 1965-66

GAURI SHANKER*

Staff:

The staff in the Department consisted of M/s. N. S. R. N. Dey, G. Shanker, B. P. Singh, S. R. Singh and I. S. Singh. The teaching of degree classes was taken by G. Shanker and B. P. Singh and Intermediate classes by S. R. Singh. I. S. Singh, research assistant, left the Department in October, 1965. Due to the sad and sudden demise of Mr. N. S. R. N. Dey, Officiating Head of the Department in December, 1965, Dr. J. B. Chitambar, Principal assumed charge of the Department. S. R. Singh worked as the extension contractman with Extension Department. G. Shanker helped in the Applied Nutrition Programme.

Research:

Introduction of fruit plants was continued. The following plants were obtained from various sources and planted in the varietal orchard for studying their performance under Allahabad conditions—G. Shanker.

Variety	*Sources*	*No. of plants obtained*
Loquat		
Golden yellow	L. R. Brothers, Saharanpur, U. P.	2 plants.
California Advance	Ditto ditto. ..	2 plants.
Plum		
Jamuni	Ditto ditto. ..	4 plants.
Kumquat		
Round	Ditto ditto. ..	2 plants.
Oval	Ditto ditto. ..	2 plants.

Response of Certain Species of Psidium to Air Layering With Aid of Growth Regulators— G. Shanker.

Three species of genus *psidium* viz. *P. cattleianum*, *P. molle* and *P. friedrichsthalianum* were studied. Three growth regulators viz. Napthalene acetic acid (NAA), Indole acetic acid (IAA) and Indole butyric acid (IBA) at three concentration of each viz. 5,000, 10,000 and 15,000 ppm were tried. The growth regulators were applied singly in lanolin paste. No rooting was observed in *P. cattleianum* and *P, Molle* in any of concentrations of the growth regulators tried. However, in *P. friedrichsthalianum*, cent per cent rooting was recorded in 10,000 ppm of IBA and IAA. However, only 50% rooting was recorded with 10,000 ppm NAA and only 20% in control.

* Associate Professor of Horticulture Ag. Int. Allahabad.

Inter Species Grafting in Genus Carissa—G. Shanker.

The inter species grafting in three species of *carissa* viz. *C. bispinosa*, *C. carandas* and *C. grandiflora* were studied. The various combinations tried, were as follows:—

S. No.	*Scion/rootstock combination*
1.	*C. carandas/C. Carandas*
2.	*C. carandas/C. grandiflora*
3.	*C. carandas/C. bispinosa*
4.	*C. grandiflora/C. grandiflora*
5.	*C. grandiflora/C. Carandas*
6.	*C. grandiflora/C. bispinosa*
7.	*C. bispinosa/C. bispinosa*
8.	*C. bispinosa/C. carandas*
9.	*C. bispinosa/C. grandiflora*

Determination of Maturity Standards of Commercial Citrus Varieties:—
B. P. Singh and I. S. Singh

The maturity standards for Mosambi, Sweet Lime, and Grapefruit were determined. The standards were based on TSS and Acid ratio, Colour break, Juice content and total acidity.

Orchard:

The orchard of acid type Guava was removed and replaced by Phalsa. The crops of Mosambi, Kinnow Mandrin and Grapefruit were very good. The orchards of guava and *aonla* were severely attacked by bark eating caterpillars which were controlled effectively by injecting petrol in the holes and plugging them. The Mosambi trees were showing severe symptoms of Zinc and Manganese. The trees were sprayed twice with salts containing Zinc and Manganese. Except for the grapefruit crop, other fruits were sold to the contractors. High temperature (118° F.) during the month of June accompanied with strong wind (*Loa*) killed several plants in the varietal orchard. The worst sufferers were, Hill lemon, Italian lemon and Sweet orange.

Published papers:

1. "Criteria for Citrus Bud Wood Selection." *The Allahabad Farmer*. **39**(5) 56-59. (B. Singh and G. Shanker).
2. "A Note on Flowering and Sex Ratio in Jackfruit." *The Allahabad Farmer*. **39** (6) 230-231. (G. Shanker and S. R. Singh).
3. "Response of Some Species of Citrus To Air Layering." *The Allahabad Farmer*. **39** (1) 32-35. (G. Shanker).
4. "Sex Behaviour in Kagzi Lime." .. *The Allahabad Farmer*. **39** (3) 73-76. (I.S. Singh and B. P. Singh).
5. "Fertilize Your Guava Plants for Bigger Yields." *Fertilizer News*. **11**(5) 19-23. (G. Shanker).

Annual Report of the Coordinator of Research 1965-66

J. C. EDWARD*

There is a fall in number of projects in operation this year as compared with that of the previous year. The factor contributing to this situation could be ascribed to the change in policy of the Research Committee to sanction projects the results of which are likely to be of practical significance and of immediate application, and discontinue those projects that are not showing satisfactory progress. This change in policy was one of the many economy measures the Institute currently has had to adopt. Efforts to secure sponsorship for the research projects from Agencies such as U.G.C., I.C.A.R.—etc. are met with reascnable success.

15 new projects were started during the year under report. In all, 11 research projects were completed and 2 were dropped for want of facilities. For details please refer table given below.

Help in framing of the proper project outlines, writing of manuscripts of Research Papers and assistance in designing and planning of the projects, analysis of data were rendered as usual by the Coordinator of Research and the Statistician. The Statistician continued to help in M.Sc. Ag. teaching programme.

Statement showing number of Projects operated during 1965-66 *by the Staff of various Departments of the Allahabad Agricultnral Institute, Allahabad.*

Department	Total No. of projects	Old	New	Sponsored by			
				SCSIR	ICAR	U.G.C.	Inst. Res. Fund
Ag. Econ. and Rural Sociology ..	..	..	..	..	..	..	
Agronomy ..	5	3	2	1	..	..	4
Animal Husbandry ..	8	1	7	..	..	..	8
Ag. Engineering ..	1	..	1	..	..	..	1
Biology ..	3	..	3	..	..	1	2
Chemistry ..	2	1	1	..	1	..	..
Dairy Tech. ..	1	1	..	..	..	..	1
Extension	..	..	..	..	..	..	..
Horticulture ..	1	1	..	..	..	..	1
Home Economics ..	..	..	1	..	..	..	1
Totals ..	22	7	15	1	1	1	19

Coordinator of Research, A. A. I.

Annual Report of Games and Sports 1965-66

L. Greenwold*

There was a great enthusiasm this year due to the Inter House system which was introduced last year. The season started with the Inter House Football matches on League Basis. There was a great participation and the House teams came with their house supporters to cheer them up in the matches. The Yellow House was the proud winner. We entered the various local Football tournaments and gave a very good account of ourselves although we lost in the semifinals. As usual we lifted the Ashok Pandya Football Trophy beating our traditional rivals Ewing Christian College across the river. Our Volleyball team did very well this year by winning two trophies out of three. We won the Newton Memorial and Malvea Memorial Volleyball trophies again beating our traditional rivals the Ewing Christian College but lost to them in another tournament which is run for the Associated Colleges of the University, nevertheless we were the runners up. In Athletics we did well in the Allahabad Christian College Sports Meet and we got the runners up position the winners position was occupied by Holland Hall. But we had the satisfaction that one of our Atheletes Francis Muguku became the Individual Champion of the Meet. Unfortunately this year we could not hold the Hayes Memorial Basketball for Men and Sohni Basketball for Women tournaments due to lack of entries. Our Annual Sports were held with great pomp and show with a students Band in attendance for the March Past. This year the participation was very great. Even the staff members took part for their house which gave encouragement to the boys. I hope in future years too, the staff members will participate and thus give impetus to the students.

In review I find the session 1965-1966 very successful.

*Physical Instructor, Agricultural Institute, Allahabad.

Annual Report of the Institute Library for the year 1965-66

M. P. THOMAS*

The work was carried on as usual by the library staff which consists of the following 9 members:—

1.	Librarian	1
2.	Assistant Librarian	1
3.	Stenotypist	1
4.	Issue Clerks	2
5.	Book Attendents	2
6.	Book Binder	1
7.	Janitor	1
	Total	9

Library Hours:

March—April and July—August	7.00 a.m. to 4.30 p.m.
Saturdays and holidays	7.00 a.m. to 1.30 p.m.
May and June	6.30 a.m. to 12.30 p.m.

At the suggestion of some members of the staff, and the Library Management Committee, certain changes were made in the timings so that the Library could remain open throughout the evening. Therefore from September to March 1965, the Library hours were as follows:—

Week days	7 a.m. to 1 p.m.
	and 2 p.m. to 8.30 p.m.
Saturdays and holidays	7 a.m. to 1.30 p.m.

All Library services were suspended from 1 to 2 p.m. although the Library was not closed and the Library Staff remained busy with various duties, such as putting back books and magazines etc.

Book Exhibition:

In order to stimulate the interest of the staff in the publications available in the Library, an exhibition of books and magazines was held in the Library in the last week of April 1966, when some old and new books, new journals, bibliographies and book lists, etc. were displayed.

Books and Journals:

The Allahabad University allocated Rs. 1,435.21 for books for the A.A.I. Library. From this amount 24 books costing Rs. 903.27 have so far been received.

*Librarian, Agriculture Institute, Allahabad.

In July 1965 the Indian Dairy Science Association gave another 14 books for its BOOK BANK here. Good use is made of these books by the I.D.D. students. The total number of issues during the year was 262.

The Development Centre continued to order books and journals through the Institute Library. The total number of books in the Development Centre on 31st March, 1966 was 290. The number of journals to which it has been subscribing is 12.

Gifts of books were received from Reader's Service, Indian and foreign government agencies, U.S.I.S., and some members of the staff and old students. The Library is very grateful to all these for their interest and their gifts. Some students contributed to 2 daily news-papers and presented them to the Library: The *HINDU* was given by the Tamil Students and *THE TRIBUNE* by the Punjabi Literacy Society.

The Library was getting 11 journals from the money given for the Extension Wing in 1963. The 3-year subscriptions of these journals having expired, 8 of them were discontinued and 3 were included on the Library's list of subscribed journals.

U.S.B.E.—Request for some books and journals was sent to U.S.B.E. and some old copies of Allahabad Farmer were despatched to them.

Old Manuscript:

During the year an attempt has been made to dispose of some old Persian manuscripts and some prints which have been lying in the Library for many years, by selling them to some other library where they could be preserved and used. Many of these were considerably damaged during the flood in 1948. The Allahabad Museum, The State Archives, The National Museum, and The National Archives have all been contacted and some tentative offers have been received but no sale has been finalized yet.

Further details about the library and its workings are given in the appendices.

Members using the Library during 1965-66

Staff	197
Wives and Children of the Staff	26
Students	566
Special Students	12
Others	9
Total	810

Statement showing use of the Library during July 1965 *to June*, 1966

SUMMARY

Books issued to Staff	3,486
Books issued to Students	19,820
Books issued in the Reading Room	23,910
Bulletins issued to Students	295
Books issued to Children of the staff	186
Journals etc. issued to staff	1,269
Total	48,966

Library Journals in 1965-66

SUMMARY

New Journals added during the year 1966-67	17
Journals discontinued during the year 1966-67	8

The Library now receives 380 different titles of journals of which more than 50% are from abroad.

Total number of Books in the Library as on 31-3-1966

	No. of Books
Total Number at the beginning of the year	27,051
Added during the year (April 1965 to March 1966) ..	641
.. ..	27,692
Less Books withdrawn during the year	115
TOTAL NUMBER AT THE END OF THE YEAR	27,577

Technical News

[1]We produce over 80 million tons of food grains from over 110 million hectares with over 130 million agricultural workers. With a large work force—1.2 worker per hectare—our farm productivity is only 0.62 ton of food grain per worker. Farm mechanization, if properly harnessed, can significantly step up our farm productivity. Good equipment makes a good farmer better. "Yield is proportionate to tillage (the reference is to equipment) as happiness to wisdom," says a Telugu proverb.

NEW PUBLICATION

Safety and Health in Agricultural Work Code of Practice[2]

This new code of practice, like those already published, has been drafted by a meeting of experts from government and industry. It contains practical recommendations for safety and health precautions in all types of farm work, and is addressed to government services, farmers' and farmworkers' organizations and to all concerned with safety in agriculture. VIII 132 pages. Price Rs. 7.88.

NEW OECD PUBLICATIONS[3]

Agriculture and Food Decumentation Series: No. 77—Advisory Work in Farm Management 198 pages: 15s.; $ 2.50.

No. 79. OECD Standard Code for the Official Testing of Agricultural Tractors. 50 pages: 5s.; $ 0.80

No. 80—Trained Manpower for Tomorrow's Agriculture. 289 pages: 27 *s.* 6*d.*; $ 4.50

SYMPOSIUM ON USE OF ISOTOPES IN PLANT NUTRITION AND PHYSIOLOGY[4]

Veinna—A symposium which provided an opportunity for exchanging information on recent advances in the use of radioisotopes in the study of plant nutrition and physiology was held in Veinna from 5—9 September, 1966. It was convened by the International Atomic Energy Agency (IAEA) and the Food and Agriculture Organization (FAO).

[5]The symposium was attended by 102 agriculturists and botanists from 27 countries and the international agency Euratom.

Previous FAO/IAEA symposia on this field of research were held in Bombay, India in 1962 and in Ankara, Turkey, in 1965; they were concerned with plant/soil relationships. This symposium focussed on mineral nutrition and its effects on plant life.

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[1] Taken from an article "Mechanization can lead to swift change" by B. K. S. Jain, received in a form of reprint from "PRODUCTIVITY" Vol. VI, No. 2 and 3, 1965.

[2] I.L.O. Samachar (Hindi) Antra Rashtri Shram Sang, New Delhi. Vol. 19, No. 1, February, 1966.

[3] The OECD Observer No. 23/August, 1966. Address on page 305

[4] FAO Release No. I/R/Press 66/121 from Food and Agriculture Organization of the United Nations, Rome.

[5] Argentina, Austria, Czechoslovakia, Denmark, Finland, France, Federal Republic of Germany, Hungary, India, Ireland, Israel, Italy, Kuwait, Netherlands, Nigeria, Norway, Poland, Republic of South Africa, Romania, Senegal, Sweden, Switzerland, Turkey, United Kingdom, Ukrainian SSR, United States of America, Yugoslavia.

Some 40 papers dealing with soil chemistry and fertility, experimental techniques, transport, assimilation, metabolism and other aspects of plant nutrition and growth were discussed. The closing session was devoted to a discussion on varying nutritional response of different crop varieties.

15TH WORLD CONFERENCE AND LEADERSHIP*

Countries in the throes of economic and social development, in an effort to mobilize all available resources, require capital, materials, manual and professional skills, the advice of experts and effective administrative structures. Bilateral technical assistance programmes and similar programmes of international and inter-governmental organizations provide for some of the needs of the developing countries, primarily by investing huge quantities of material resources, making available highly qualified experts in industrial technology, agriculture, health and education, and by training local personnel to assist in the planning of national development. But in all this there is a basic need that cannot be entirely met by the most efficient and carefully devised assistance programmes—need for local "leadership", without which the process of national development is severely compromised.

The need is not only for leaders who will win medals in times of disaster or emergency; probably the greater need is for leaders of a less dramatic kind, for men and women who by their example lead others to an awareness and understanding of the difficulties facing the society and to a sense of responsibility and determination to work toward a solution.

It is therefore vital to a growing nation that its native leadership resources are cultivated and brought to maturity and that through its formal and informal institutions, youth are instilled with a sense of responsibility and initiative. We believe thatin this area voluntary service organizations are particularly able to make a unique and important contribution to the preparation of young leaders within communities.

For this reason the Coordinating Committee has chosen as the theme for the 15th Conference of Organizers of International Voluntary Service: "Voluntary Service and Leadership—initiative and Responsibility. "The conference opened on February 20th in Rosario, Argentine. For eight days organizers of voluntary service from all continents considered in which conditions short and long term volunteers help the emergence of leaders in a commnuity, and in which conditions voluntary service develops qualities of leadership in the volunteers themselves. This was the first time that the Coordinating Committee has held its biennial conference in Latin America. In the last ten years conferences have been held in India (1953), Yugoslavia (1960) and in the Cameroons (1962).

The 14th Conference was held at Linz, Austria (1964) and had a related theme: "Voluntary Service in the United Nations' Development Decade."

Young Esperantists to cooperate with "Moulin des Apprentis"

No matter how successful work-camps may be, they still have their problems....but could we expect otherwise? Difficulties must arise when thousands of young people come together from many countries and backgrounds. Communication problems, for one,seem inevitable.

*"Workercamps Across the World" Vol. 6, No. 4, Winter 1965-66.

"Mouline des Apprentis," a well-known French work-camp organization, recognizes the possibility of an international language to overcome this difficulty. In the past it has often used Esperanto (the foremost proposed "international language)" on a small scale in its publications.

In August 1966, at Mouline Malval near Bonnet (Creuse), the organization of Young Esperantists to integrate into the work-camp programme a four day course in Esperanto for newly arrived volunteers. It is hoped that this experimental course demonstration after only a few days of instruction will be able to help to exchange simple ideas and thereby get along better while sharing their common work-task with young participants from different language areas. After the initial course, two hours of conversational Esperanto was included in the daily schedule to enable the work-camper to become more adept in this international language. If the experiment proves successful, an increased use of Esperanto is foreseen.

World Organization of Young Esperantists
(Netherlands)

COOPERATION AND THE FAMILY FARM IN ISRAEL*

Any discussion on the role of the family farm, in a technological age, can only proceed from two basic assumptions:

A—that in a modern society the preservation of the family farm within the village community is desirable because of the part it plays socially, economically and in security; and that such preservation should occur in spite of technological development and the trend to urbanization.

B—that modern society deems it desirable to have an educated, progressive,farmer with a reasonable living standard, and an agricultural contributing to the national economy and not a liability to it. The achievement of the above is conditional on a modernized agriculture making use of the available scientific knowledge.

However there is conflict between these two conditions. Modern agriculture is characterised by the following:

(*a*) It is generally organized on a large-scale both for production and capital investment. It is greatly industrialized and the farm unit is becoming increasingly larger. An increase in the rate of productivity larger than the increase in the rate of consumption necessitates a periodical reduction in the number of farmers required. In so doing it works to the detriment of the agricultural society and mainly to the detriment of the small farmer.

(*b*) Modern agriculture is commercialized and therefore depends on market conditions; i.e. price fluctuations and fluctuations in the demand for different crops. Since such changes are frequent and extensive, they demand a degree of adeptability to a variety of conditions, which is impossible to achieve in an individual family farm.

* Taken from "News from Israel", Vol. No. 4, February 15, 1966 published by Reuven Dafni, Consulate of Israel, 50 Pedder Road, Cumballa Hills, Bombay. 26

(*c*) The continual variation of crops, the need for pest control, the use of different methods of fertilization and cultivation, demand a high degree of specialization and scientific knowledge which cannot be mastered by any one individual.

(*d*) Improvements in farm machinery and equipment, improvements in the economic services, advances in harvesting, grading and marketing methods, demand large capital investment, as well as the follow-up and assessment of the continual improvements and changes taking place in this field.

(*e*) Modern agriculture, like modern society, is an organization complex, increasingly dependent on the developing services. This requires contact on many levels with the State and other administrative institutions characteristic of modern society.

All these aspects of modern agriculture make it difficult for the individual family farm to hold its own.

Solving the problems set by the technological age, so as to preserve the family farm is, therefore the challenge of the cooperative movement. The task of the cooperative movement is, not to fight technological advances, but to merge it with the family farm by introducing technology into it; on the principle that "if you cannot beat them join them."

The extent to which this challenge can be met, in the diverse fields of modern agriculture, and the extent to which any individual family farm is capable of survival and development, are problems for discussion. It is possible that some of the answers could be found in the example, taken from the Israeli situation, which shows how a cooperative settlement is established, through and because of modern technological advances.

THE MOSHAV*

The principle of the moshav is based on two assumptions; that the small family farm cannot operate efficiently without an organization which enables it to receive certain services jointly with neighbouring farms and other villages; and the appropriate, efficient and just form of organization is a cooperative one. This form of organization can be established by two ways:

***The Moshav:**

In the Moshav all produce is marketed and all supplies are purchased cooperatively; to a limited extent production is also cooperative. The Moshav is based on the individual family unit. Each family independently forms its own allotment, and the income of the family is determined by the quantity of produce it remits to the central marketing office of the Moshav. Cooperation in actual production is usually limited to the common ownership of heavy equipment, which is rented to individual members when they require it. More extensive co-operation in production may, of course, be undertaken by a group in which social relationships and farming conditions are favourable. All the requirements of the family are purchased in the cooperative store in the settlement. The allocation of a limited area of land to each family secures a broad uniformity in living standard throughout the Moshav.

There are 227 moshavim (MOSHAV—plural moshavim)in Israel with a total population of over 87,000.

(*a*) To introduce cooperation in existing villages, which is the situation in most parts of the world; or

(*b*) to establish villages on a cooperative basis from the moment they are founded, as in the Israeli Moshav was planned after an analysis of the village situation in the world, with a view to the prospect of technological development and in accordance with a philosophy of life which sought the establishment of a just society in which there will be no underprivileged members. From its beginning the Moshav has insisted on cooperation in the essential services, and mutual responsibility for all member-settlers. Co-operation and mutual aid has always been its guiding principle in municipal affairs, in education, in cultural affairs, in welfare, etc., as much as in the purely economic fields of marketing, purchasing and credit.

From the first, the Moshav has insisted on a comprehensive cooperative, within which members could organize collaboration for the satisfaction of secondary needs, subject to the approval of the village as a whole. Provision was also made for the supply of certain auxiliary services by independent workers under the supervision of the cooperative.

The founders of the Moshav movement laid down that Moshavim should only be established on nationally owned land which could not be sold or sub-divided, and that farms should be equal in size and no larger than could be cultivated by one family without recourse to hired labour.

As a comprehensive cooperative settlement, the Moshav has a far-reaching influence on all aspects of life. As a matter of social philosophy, as well as from economic considerations, the Moshav is concerned that none of its farms should be backward or economically weak, and that all should operate at maximum efficiency. When more milk is delivered to the collecting station, the cost of the service per unit of production is lower, and production is more likely to increase by giving help to a farm not producing to capacity, than by stepping up production in the already efficient farm.

Contrary to the rule of competition and "natural selection" which operates in the non-cooperative village, the cooperative village is interested in helping the backward farms as a matter of overriding community interest. Thus, the Moshav channels more help and credit to the needy farm; and the more the Moshav observes strict cooperative rules, the better is it able to do so. In such Moshavim, the production gap between members has been reduced and the general standard is incomparably higher than in other villages, since by strengthening and stimulating its less productive members, the village as a whole is able to progress and develop.

The cooperative village must know how to differentiate between farms which are temporarily lagging behind because of chance failures of family conditions and which can be rehabilitated with the assistance of the Moshav and the incurably backward unit.

In order to supply credit, to rehabilitate the farms in needs and to launch cooperative ventures, the Moshav needs heavy investments which can be obtained by raising local capital and borrowing from outside, such credit is only obtainable on the basis of mutual responsi-

bility and mutual guarantees. It is easier therefore for the Moshav to assist the individual farm; but at the same time mutual dependence increases.

Cooperation in local government activities—education and culture, sanitation, public health—also contributes to the welfare of the family farm and of the village community, since it provides a fertile field of joint civic activity and an opportunity to develop social life through the establishment of study circles, amateur groups and the like. Thus, it serves as a weapon against urbanization and against the dispersal of the village community. Since the village as a whole is responsible for the cost and supply of education and other services given equally to all members, social differentiation is greatly reduced and there exists a feeling of equality and partnership.

The effect of cooperation on village life and development is clearly visible if conditions in Moshavim are compared with conditions in other villages founded at the same time. A comparison of social and economic conditions between settlements of the same age with similar agricultural conditions and having the same type of population, shows a surprising difference in development. The difference is mainly due to the fact that the ordinary village did not accept the principle of co-operation and of non-parcelling and sale of land in some villages, where the settler started off with farms of equal size, within one generation, there was on the one hand concentration of land in a few hands and on the other hand some farms had split up into units too small to provide their owners with a living. Thus a situation was created in which the large farm did not need aid and cooperation, while the small ones were too small to allow their owners to exist on agriculture; and had become auxiliary farms.

REGIONAL DEVELOPMENT

The nature of development is such that the requirements of the individual, the enterprise and the village, increase continuously. This applies to the range and volume as well as to the standard of services; and as the range of services needed by the village grows, so do the technical difficulties involved in supplying them adequately. Thus any farmers' family, and particularly any smallholders' family must affiliate itself to a large organization which can provide those services.

As a result of this development, there is now in Israel a marked trend towards expanding agricultural cooperation at all stages and in all forms both within and beyond the Moshav. As noted, technological progress has created vast needs of mechanization in grading, packaging, marketing, transport and fodder supply for livestock. The Moshev's answer to this need has been to establish the necessary new services exclusively on a cooperative basis and even to convert such services as had been supplied independently into cooperative ventures. Now, there is a gradual transition from local to regional and from regional to national cooperation.

In general, the growth of the higher-level organization means that the lower-level organization grows weaker. But the primary organization continues to fulfil a valuable role, at least as representing the village as a unit in its dealings with the regional organization. It

may be noted that the transition from the local to the regional and national level is characteristic of almost all branches of production and services.

Citriculture in Israel, for instance, can nowadays hardly be envisaged without its country-wide organization. Water supply for agriculture has developed on similar lines: from individual wells to joint well serving a number of farms, thence to village wells and regional water works.

There was a time when every citrus grower packed his own crop in his own primitive packet shed. In due course, packing sheds catered for several growers or for a whole village, until the present stage of large mechanized regional grading and packing plants administered by a national marketing board with legal powers, was reached. Without this compulsory cooperative organization, one could today hardly envisage the existence of so many citrus growers with small groves; left to their own devices, they would have been forced to subsist with a low living standard, and an ever increasing number of groves would have been owned by large estate owners.

Israel has now established its nation-wide supply system of the National Water Carrier which is owned and run by a company based on cooperative principles whose authority derives from legislation.

In the last ten years, new settlements have been systematically established as part of a planned regional organization.

So far, we have mainly considered cooperation as a means of allowing the family farm and the village to keep pace with modern technological progress. In fact, there have been similar developments in the field of education, cultural activities and entertainments, such as the establishment of regional schools amphitheatres, etc.

Modern society and the modern State are characterized by a high degree of organization. We live in a planned State, with extensive public controls and comprehensive economic planning. One can hardly envisage how Israeli agriculture would have been able to handle agricultural planning and coordination of production, if it had not been able to avail itself of all the cooperative societies of the Moshavim, which enables the State to deal with a few hundred villages instead of with tens of thousands of individual farmers. Matters of welfare policy, national and health insurance and membership of farmers' organizations are also streamlined, since the cooperative charges itself with such organizational procedures as registration, collection of fees, payments and making returns. Clearly, the cooperative village is a natonal instrument of the first order in introducing the modern social age to the family farm. But if it is to fulfil this function, it must also be equipped with local government and other organizational powers. The individual family farm is likely to be ground to dust by the wheels of technological progress; and individual man and his family are likely to be lost in the impact of modern social development. The cooperative village, based on comprehensive cooperation and imbued with the spirit of mutual responsibility has proved invaluable in strengthening the family farm and the village community and in enabling them to adapt to the changing times and to overcome those negative aspects which have characteristically marked the non-cooperative village.

The establishment and existence of such a village require a high level of civilization and great mutual trust. It is most essential to have a nucleus of members who assume the responsibility for public affairs and to activate as large a number of settlers as possible in all fields of cooperative life. This, in turn, requires education in the principles of cooperation. For the organization is no more than a tool. The individual settler sometimes feels that the existence of a compulsory comprehensive cooperation deprives him of his freedom and initiative, and it is not easy to explain that the alternative to stability and security is the disruption of the social and economic basis for his existence as an individual and family farmer. The transition from village to regional organization tends to deprive the cooperative village community of its meaning.

The problem of the rehabilitation or liquidation of the unsuccessful farm is a complicated economic and social problem. So is the need to enlarge the farm unit and reduce the number of farmers; it is a problem which is far less easily solved in a cooperative community with mutual responsibility than by means of the free play of competition and "natural selection."

To sum up: The family farm, as sound basis unit of modern society, can only be preserved if it can adapt itself to the times. The cooperative settlement is a highly effective instrument for this purpose; without it, the family farm cannot exist in present condition; with it, the unit can be adjusted to modern technology, to its own benefit and that of the whole country.

MILK PROVIDES NEW ANTIBIOTIC*

A new anti-bacterial drug, called "caseicidin" has been isolated from milk by an Israeli scientist working jointly with a scientist of the Royal Danish Institute of Copenhagen. In laboratory tests, caseicidin has proved to be effective against **Staphylococcus aureus,** the cause of septic wounds and boils. This is particularly important as strains of penicillin-resistant **Staphylococcus aureus** tend to develop and spread. As caseicidin is produced in quantity from milk by a biochemical process, it is expected to cost less than antibiotics at present marketed, and to have no side-effects.

The discovery was made incidentally as a result of basic research conducted by Dr. Eitan Lahav, of the Volcani Institute of Agricultural Research, on what happens when rennin is added to casien, the main protein of milk. The discovery of penicillin, which revolutionized medicine, was also incidental in the course of basic research.

Rennin is the substance extracted from the fourth stomach of a calf, which has the power of clotting milk to form cheese. The process of cheese-making has been known for thousands of years. Yet modern scientists are still wrestling with the problem of the exact nature of the complicated biochemical processes involved in this clotting of casein.

Dr. Lahav, in studying these processes, found that some fractions of the casein are rennin-sensitive and clot, while others do not. In these rennin-sensitive clotting fractions, a bond of certain molecules, positively charged, is split off. This bond of molecules puzzled Dr. Lahav, who suspected them of having anti-bacterial properties.

* Taken from "News from Israel", Vol. XIII, No. 4, February 15, 1966. Published by Reuven Deafni, Consulate of Israel, 50, Padder Road, Cumballa Hill, Bombay—26.

Because of problems they were having with cheese-making in Denmark's famous cheese industry, the Royal Danish Veterinary Institute was interested in Dr. Lahav's work on the action of rennin on casein. They were finding that the quality of the cheese varied unexpectedly according to the batches of milk. Dr. Lahav was invited to go to Copenhagen, where he had been before as a student and assistant lecturer, to work together with Professor S. T. Sode-Mogensen.

During the course of their work, the antibiotic properties of positively charged molecules that were split off from whole casein, and its fractions, alpha, beta and gamma-caseins were analyzed. It is the beta-casein, named by them "caseinidin" which is proving to be the mortal foe of **Staphylococcus aureus.**

The new process of isolating the anti-bacterial drug caseicidin from casein evolved by Dr. Lahav during the course of his basic research is neither difficult nor expensive and yields large quantities of the antibiotic cheaply. The discoverers of caseicidin are now negotiating to produce it on a commercial scale.

*FIFTH ANNUAL HIGH-LEVEL MEETING OF THE OECD DEVELOPMENT ASSISTANCE COMMITTEE

The World Food Problem:

The Committee concluded that the outlook was grave. Given current trends of food production and population growth, there is insufficient food production to meet basic nutritional requirements in the world, and the imbalance between supply and demand is serious in those developing countries where population growth is most rapid and where efforts to increase crop yields have been least successful. The developing countries, which a little more than a generation ago were net exporters of food, have become increasingly dependent on food imports from the developed countries, and last year imported some 25 million tons of food grains, two-thirds on concessional terms. But even these imports have not solved the problems of hunger and malnutrition.

The Committee recognized that the basic solution must be found within the developing regions themselves and that a sustained and comprehensive effort by the developing countries would be required. The Committee recognized that this effort would require their support and recommended that its Members take the necessary measure.

The Committee recommended that greater emphasis be given to agriculture in aid programmes, and that interim food aid should continue to be provided under conditions which would encourage the developing countries to increase their own agricultural productivity. The Committee decided to keep under review the food situation in the developing countries and the assistance to agriculture provided by its Members through bilateral and mutilateral programmes in order to increase its effectiveness. It invited the Secretary-General of the OECD to oconsult with Member governments and with the heads of international organizations, and to report on how to increase the effectiveness and co-ordination of bilateral and multilateral programmes aimed at increasing food production and improving nutritional levels in the developing countries.

* Published by Orgainsation for Economic Co-operation and Development, Chateau de la Muette—2, rue Andre—Pascal, Paris 26—TRO. 22—30 July 21, 1966.

FOOD PROBLEMS IN THE LESS DEVELOPED COUNTRIES

The most recent estimates concerning population growth and agricultural production have prompted rising concern about food shortages in a number of the more populous less developed countries. Agricultural yields are not improving sufficiently to keep pace with the rapid population growth. A number of developing countries are becoming increasingly dependent on food imports beyond their ability to purchase on commercial terms.

Being concerned about this state of affairs and the prospects it reveals, the member countries of the Development Assistance Committee (DAC) of the OECD will give close attention to this matter at their meeting in Washington on 20th and 21st July. They will consider a recommendation that in the future more emphasis should be given to agriculture and particularly to food production in the less developed countries. The members of DAC feel that they can assist the developing countries considerably in accomplishing the task of raising their agricultural productivity by providing capital and technical assistance. However, the major initiatives must be taken by the less developed countries themselves.

To remedy the situation is a question not only of changing ancient methods used by scattered millions of tradition-bound farmers but also a question of providing credit, transportation, storage and organized markets.

Food requirements are increasing continuously as a result of population growth, the continuing move of people to urban centres and to some extent as a result of higher incomes in the cities. Large sectors of the population, particularly women and children are at present exposed to serious malnutrition, especially as a result of insufficient animal protein consumptien.

It present population trends continue and expected growth in demand is to be met largely from local sources, food production in the less developed countries would have to rise significantly faster than at its recent rate.

The less developed countries taken as a whole were formerly net food exporters but this situation has been reversed since the Second World War. Asia, in particular, which in the pre-war years was a net exporter of grains, is expected to import some 30 million tons in 1966. Furthermore, surplus agricultural stocks in North America have been substantially reduced and present levels of wheat stocks are considered no more than sufficient for the carryover from one harvest to the next.

Increasing agricultural output by bringing new land into cultivation is becoming more difficult as good land is becoming more scarce or more costly to develop. Reliance must be placed, therefore, on increasing yields per acre in many of the most populated less developed countries.

The solution of the food problem in the less developed countries is a long-term one, but steps must be taken soon if the problem is to be solved without recurring food crisis conditions and perhaps famines. A number of less developed countries have recognized that present rates of population growth threaten to wipe out a good part of the gains from development efforts. Population control measures cannot contribute noticeably in the immediate future to reducing the pressure of population on the available food resources, but if such

measures are taken or reinforced within the next few years they could help greatly in solving the world food problem in the decades ahead.

As an immediate step and for an interim period, food aid can bring some relief; advantage should, however, be taken of the avilaule food aid to increase output in the less developed countries themselves. The proposed Food for Freedom legislation, now pending in the United States Congress, emphasizes this objective. Care must also be taken that food aid does not adversely affect farm incomes or disturb normal trade channels.

Agriculture and fisheries in the less developed countries have not received the same attention as many other sectors of the economy. Where a development effort has been made in agriculture it was usually for export crops and the associated marketing facilities.

Acknowledgment of the primary importance of food production implies that additional physical and technical facilities must be allocated to it; but there must also be a series of institutional measures and policies which will give farmers the incentives to adopt new technologies. More generally speaking, it must be recognized that agriculture is one of the main income-earning sectors of the economy and that it can be a big market for other industries.

Greater emphasis on domestic food production does not mean, of course, that every less developed country should necessarily become self-sufficient in food. Account must be taken of the possibilities for an expanding volume of trade among these countries as well as between them and the rest of the world.

The first, and possibly the most difficult, problem may be to get the farmers interested in increasing their output. This will sometimes imply important institutional and administrative changes which will take time to put into effect and which may not bring immediate results.

If a country is determined to increase agricultural yields, it can do so by drawing on the stock of knowledge existing in the developed countries although, it must be added, many of these techniques still need to be adapted to local conditions.

During the last 25 years, yields per acre rose by over 100 per cent. in North America and by more than 30 per cent. in Western Europe: during the same period, they rose by only about 8 per cent. in the less developed countries. These impressive results for the OECD countries can give useful guidance, even allowing for the special conditions prevailing in the less developed countries. In practice there is room for much heavier use of fertilizers and pesticides, improved crop varieties and the adoption of modern methods of livestock production. Also required are an extension of such essential services as research, credit, marketing and transport. Advisory services are also needed to disseminate technical knowledge on farm production itself and on the marketing of produce.

The yearly consumption of fertilizers per hectare, for instance, is at present less than 7 kg. in the less developed countries, whereas it is estimated to be in the region of 51 kg. in the developed countries. For Asia it is estimated that their yearly consumption of fertilizers would have to increase by more than 6 times their present consumption if their future grain requirements are to be met from local sources.

Several decades may elapse before food production in the less developed countries can be raised to the level where remaining deficits can be met from local production or through the normal processes of international trade.

In the meantime, food aid may be able to fill at least a part of the gap. The volume of food aid in 1964 amounted to U.S. $ 1.5 billion.

The developed countries would be in a position to raise their present levels of production to a considerable degree if this were necessary. Exportable surpluses could also be produced in a number of less developed countries in Latin America and the Far East.

Future levels of world food production and international trade in foodstuffs closely depend on a large number of factors including international commodity arrangements, as well as on the amount of aid given to developing countries.

Book Review

"Consumers' Cooperation in India." Dr. S. C. Mehta, M. Com., LL.B., Ph.D., published by Atma Ram & Sons, Kashmiri Gate, Delhi-6, in1964, Price:Rs. 20.

This book was originally submitted for the award of Ph.D. Degree. It was revised twice to bring it up to date. The book is divided into several chapters, dealing with origin, history, Consumers' Cooperation in Foreign Countries, India and Various States in India, Operation of Consumers' Cooperation, Account Keeping, Types of Stores, Case Study of Successful Stores, State and Cooperative Movement, Cooperative Education,Maintenance of Status of Consumers' Cooperation, Present Position and Future with Suggestions for Improvement. It includes also the model bye-laws of the Consumers' Cooperation.

This book will be useful to the laymen, organizers of the Stores and serve as an useful text book for the college and University students apart from the trainees of the Cooperative Training Centres.

The author has taken liberty to quote emminent cooperators thus making the book authoritative. The language is good and simple.

The book assumes special importance in the present time when consumers' Cooperation is often discussed in the daily papers, touching the effects of rising prices and devaluation It is must for those who are interested in Consumers' Cooperation and want to acquaint themselves with the latest developments in the field of Consumers' Cooperation.

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